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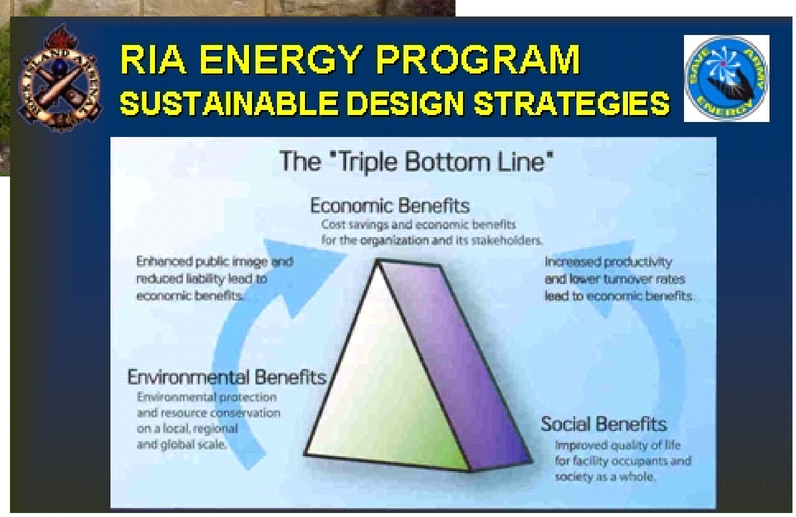
US Army Corps of Engineers®
Engineer Research and Development Center

Process and Energy Optimization Assessment Level II Analysis

Rock Island Arsenal, IL

Mike C.J. Lin, Alexander M. Zhivov, David M. Underwood, David I. Osborn, Alfred Woody, Walter P. Smith, Curt Bjork, Michael J. Chimack, and Robert A. Miller

August 2005



Construction Engineering Research Laboratory

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Final Report

Approved for public release; distribution is unlimited.

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ABSTRACT: In summer 2004, researchers from the Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL) led a Level I Process and Energy Optimization Assessment at Rock Island Arsenal (RIA). The team identified 36 process and energy improvement ideas that could significantly improve the RIA manufacturing mission readiness and competitive position. Arsenal staffs selected 28 measures for a follow on Level II analysis. This report documents the Level II analysis results and provides recommendation of 15 "appropriation grade" process improvement projects for Army Energy Conservation Investment Program (ECIP) funding application. If implemented, these projects were estimated to yield annual savings of \$0.57M with a total investment of \$1.5 M for an average simple payback of 2.6 years. ECIP funding guidance is also included in this report.

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Conversion Factors

Non-SI* units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
acres	4,046.873	square meters
cubic feet	0.02831685	cubic meters
cubic inches	0.00001638706	cubic meters
degrees (angle)	0.01745329	radians
degrees Fahrenheit	(5/9) x (°F – 32)	degrees Celsius
degrees Fahrenheit	(5/9) x (°F – 32) + 273.15.	kelvins
feet	0.3048	meters
gallons (U.S. liquid)	0.003785412	cubic meters
horsepower (550 ft-lb force per second)	745.6999	watts
inches	0.0254	meters
kips per square foot	47.88026	kilopascals
kips per square inch	6.894757	megapascals
miles (U.S. statute)	1.609347	kilometers
pounds (force)	4.448222	newtons
pounds (force) per square inch	0.006894757	megapascals
pounds (mass)	0.4535924	kilograms
square feet	0.09290304	square meters
square miles	2,589,998	square meters
tons (force)	8,896.443	newtons
tons (2,000 pounds, mass)	907.1847	kilograms
yards	0.9144	meters

***Système International d'Unités* ("International System of Measurement"), commonly known as the "metric system."

Preface

This assessment is a part of show-case studies conducted by Construction Engineering Research Laboratory (CERL) at four sites (Rock Island Arsenal, Sierra Army Depot [AD], Tobyhanna AD, and Corpus Christie AD), which were selected by the Army Materiel Command (AMC) to demonstrate energy reduction opportunities at industrial organic facilities and to promote the Lean concept and ways how to render these facilities more efficient. The study conducted for Rock Island Arsenal (RIA) was done under Project Requisition No. 2003-6060, "Analyze Factory Energy Processes," via Military Interdepartmental Purchase Request (MIPR) No. 4H13LRG040. The technical monitor was David Osborn, Energy Manager, Rock Island Arsenal.

The work was managed and executed by the Energy Branch (CF-E) of the Facilities Division (CF), Construction Engineering Research Laboratory (CERL). The CERL principal investigators were Dr. Alexander Zhivov and Dr. Mike C.J. Lin. Appreciation is owed to David Osborn (RIA) for his coordination of the RIA team and to the RIA Directorate of Public Works (DPW) and Joint Manufacturing and Technology Center staff, who contributed significantly to the information gathering and analysis feedback. Major contributors to the study were Alfred Woody, Ventilation/Energy Applications, P.L.L.C., Walter Smith (Energy Technology Services International, Inc. [ETSI]), Curt Bjork and Patrik Bergvall (Curt Bjork Fastighet & Konsult AB, Sweden), Michael Chimack and Robert A. Miller (Energy Resource Center, University of Illinois at Chicago [UIC]) Special thanks are owed to the Department of Energy Office of Industrial Technologies (DOEOIT) and Federal Energy Management Program. Dr. Tom Hartranft is Chief, CEERD-CF-E, and Mr. L. Michael Golish is Chief, CEERD-CF. The associated Technical Director is Paul A. Howdyshell CEERD-CV-T. The technical editor is William J. Wolfe, Information Technology Laboratory. The Director of CERL is Dr. Alan W. Moore.

CERL is an element of the U.S. Army Engineer Research and Development Center (ERDC), U.S. Army Corps of Engineers. The Commander and Executive Director of ERDC is COL James R. Rowan, and the Director of ERDC is Dr. James R. Houston.

1 Introduction

Background

Rock Island Arsenal is an established leader in energy conservation receiving top recognition a number of times in the past for energy reduction accomplishments. The Arsenal's industrial complex benefited from a major industrial renovation program in the 1980s and 1990s which consolidated industrial facilities and installed state-of-art manufacturing technologies in a world-class energy efficient complex. More recently, an effort was completed to install the latest state-of-art HVAC controls and lighting technologies throughout the industrial area with an ESPC contract. Thus the majority of the industrial facility utilizes the best available technologies in energy efficiency. The purpose of this project was to re-assess the industrial complex using a highly qualified industrial team to define all remaining highly cost effective conservation measures.

During the past few years, the U.S. Army Corps of Engineers, Construction Engineering Research Laboratory (ERDC/CERL) led process and energy optimization initiatives to assist DOD installations in meeting energy efficiency and environmental compliance requirements and to create an improved work environment through a "Process and Energy Optimization Assessment" (PEOA). The key elements that guarantee success from a PEOA are: (1) the involvement of key facility personnel who know what the problems are, where they are, and have thought of many solutions; (2) the facility personnel sense of "ownership" of the ideas, which in turn develops a commitment for implementation; and (3) the PEOA focus on site-specific, critical cost issues, which, if solved, will make the greatest possible economic contribution to facility's bottom-line. This work would complement the ongoing Army Materiel Command's "Lean Thinking & Six Sigma" implementation.*

In June 2004, a team of Army researchers and expert consultants performed a Level I PEOA at Rock Island Arsenal (CERL Report TR-04-17) which identified 36 proc-

* U.S. Army Materiel Command Transformation White Paper, Approved by General Paul J. Kern, July 2003

ess, energy, and environmental opportunities that could significantly improve the RIA manufacturing mission readiness and competitive position. Researchers quantified 23 of these measures with preliminary capital investment requirements, and estimated savings and payback periods. Responsible Arsenal personnel reviewed the Phase I report and selected a list of desired projects for a follow on Level II analysis (Table 1). The team reconvened during the week of 29 November 2004 to further evaluate these prioritized opportunities via a Level II PEOA.

Table 1. ECMs selected for the Level II Study.

Item	Location	RIA Phase 2 Request
1	Plating Shop	Request all six plating shop Energy Conservation Measures (ECMs) be addressed in the Level II assessment
2	Paint Booth	Request PN#1, Enclose Drive – Thru Paint Booth, be addressed in the Level II assessment. This will help us reduce the negative building pressure in that area and should conserve significant energy. Consider including a heat recovery system.
3	Heat Treat	Request development of HT#1, Install Thermocouples To Provide Uniformity Surveys for Furnaces in Bldg. 222
4	Heat Treat	Request development of HT#3, Install an Endothermic Generator (methanol and nitrogen)
5	Heat Treat	Request the Level II assessment include re-engineering of the HVAC system for building 222. The environment is too cold when processes are off and too smoky when processes are running. This is our top priority in this shop
6	Heat Treat	The Arsenal will address HT#2 and HT#4
7	Machining	Request MC#1, Install Radiant Heaters in bldg 220 be included in the Level II assessment
8	Foundry	Request FD#1, Replace Critical Foundry Equipment, be included. This ECM may not need much development. We would like it included for potential funding consideration.
9	Foundry	Request FD#2, Improve Ventilation in the Foundry, be included. This area also has a negative pressure concern. Assess maintenance problems versus potential system improvements.
10	Welding	Request WD#1, Replace Extraction Arms with New Exhaust System, be included.
11	Building Envelope	Request BE#1, Improve Work Conditions in Crane Bay Bldg. 220, be included. Primarily, this ECM permanently closes the windows. Request assessment of ventilation systems to assure adequate summer cooling.
12	Building Envelope	Request BE#2, Install High Speed Doors, be included. This will compliment BE#1 and improve other areas.
13	Building Envelope	The Arsenal will address BE#3.
14	HVAC Systems	Request BH#1, Improve Ventilation in Rapid Response Mfg Cell, be included.
15	HVAC Systems	The Arsenal will address BH#2, 3, & 4. But consider assessment of variable speed drives in the plating shop. However, be aware one unit was done and there may be a reason to not continue.
16	HVAC Systems	Request BH#5, Install Separate Cooling Unit, and BH#6, Install On/Off Dampers, be included for potential funding consideration. Significant project development may not be required.

Item	Location	RIA Phase 2 Request
17	HVAC Systems	Request BH#7, Heat Recover in Paint Booth – Bldg. 299, and BH#8, Indoor Air Quality – Bldg. 299, be included
18	HVAC Systems	May include BH#9 in the general assessment requested of Bldg. 222 HVAC problems
19	Compressed Air	Eliminate CA#1, Increase Pressure Gap, already implemented. Also eliminate CA#2, Reduce Compressed Air Leaks, the manufacturing maintenance should proceed on their own.
20	Lighting	Request LT#1, Install Spot/Task Lighting, be included. This should require minimal development. We need specifications and sources.
21	Lighting	Eliminate LT#2, Replace T-8 Lamps, the Arsenal will consider this through base operations. Also eliminate LT#3, Night Light Improvements, the Arsenal will implement through small projects.
22	Boiler Plant	Request BP#1, Upgrade the De-aerator Tank, should be included for funding consideration.
23	Boiler Plant	Eliminate the remaining boiler plant ECMs. The Arsenal will address those through other ongoing studies.

Objectives

The objectives of this study were to conduct an in-depth analysis of a number of selected process and energy systems improvement ideas generated in the Phase 1 study and to develop a group of "appropriation grade" performance improvement projects for funding and implementation. The study focused on industrial facility efficiency improvements with emphasis on LEAN and sustainable design principles. Another purpose of this project is to establish the Arsenal as an industrial showcase facility and then promote these technologies at other sites.

Approach

There are three levels of process and energy analysis which differ in the objectives, scope, methodology, procedures, required instrumentation, and approximate duration:

Level I. Preliminary energy and process optimization opportunity analysis (walk-through review; no instrumentation with basic analysis). A Level I audit usually takes from 2 to 5 days and allows identification of the dollar potential for process improvements and energy conservation to the bottom-line. No engineering measurements are made. The existing processes are challenged, and new practices and new technologies are considered. A Level I Audit would normally be followed by a Level II process audit to verify the Level I assumptions and to more fully develop the ideas from the Level I screening analysis.

Level II. Energy and process optimization analysis geared toward funds appropriation. (calculated savings; partial instrumentation with cursory analysis). A Level II study typically takes 5 to 10 times the effort of a Level I, and could be accomplished over a 2- to 6-month period, depending on the scope of the effort. The Level II effort includes an in-depth analysis in which all assumptions are verified. The end product from Level II is a group of "appropriation grade" process improvement projects for funding and implementation.

Level III. Detailed engineering analysis with implementation, performance measurement and verification (M&V) assessment; fully instrumented diagnostic audit; 3 to 18 months in duration.

For the Level II analysis, ERDC-CERL organized a project team consisting of CERL researchers and expert consultants from the following organizations: the U.S. Department of Energy Office of Industrial Technologies Industrial Assessment Center at University of Illinois at Chicago (UIC), Ventilation/Energy Applications, PLLC (VEA), Energy Technology Services International, Inc. (ETSI), Curt Bjork Fastighet & Konsult AB (CBF&K), and several industry partners including PlymoVent Inc., Johnson Controls, Inc., and Palm International, Inc.* (Figure 1)

Figure 1. PEOA team members with the RIA energy manager David Osborn.

During the Level II assessment, the assumptions made in the Level I study were verified and a more precise costing and saving calculations were provided. Engineering measurements were made wherever necessary.

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* In this rare instance, the supplier was included on the team to help determine technical and economic feasibilities at RIA and to provide reliable cost estimates. Currently, Palm cover technology is being demonstrated at the Naval Aviation Depot in San Diego; it is the only technology researchers found with the potential to meet the proposed most stringent emission limit (1 microgram per cubic meter).

Scope

The scope of the Level II analysis included improvements in plating, painting, machining, welding, foundry, and heat treatment shops, building envelope, heating, ventilation, air conditioning systems, lighting, and steam boilers. Life cycle cost analysis (LCCA) for each of the recommended ECIP ECM was performed. ECIP funding guidance is also included for developing energy conservation, water conservation and renewable energy projects that increase efficiency, enhance mission capabilities, and reduce negative environmental impacts of energy systems.

Mode of Technology Transfer

The LCCA results obtained in this study can be used by the Arsenal to prepare the DD1391 form for FY07 Army ECIP funding application. Support of project implementation and savings verification can be provided after funds are secured. It is planned to disseminate the major findings of general interest resulted from this study among other AMC depots, DOD and other governments agencies and private sector via presentations at specialized workshops and professional industrial energy technology conferences. This report will also be made accessible through URL: http://www.cecer.army.mil

2 The Level II Process and Energy Optimization Assessment at Rock Island Arsenal

Major RIA Production Areas and Associated Processes

Rock Island Arsenal is noted for its expertise in the manufacture of weapons and weapon components, which are provided to both domestic and foreign markets. Every phase of development and production is available.

Manufacturing capabilities include forging, machining, finishing, foundry work, soft materials fabrication, tool, die and gauge manufacturing, spare and repair parts production, and prototype fabrication. Most of these production operations were consolidated under one roof more than a decade ago. Figures 2 and 3, respectively, show the Rock Island Arsenal Industrial Complex and the Major Charles B. Kingsbury Manufacturing Center.

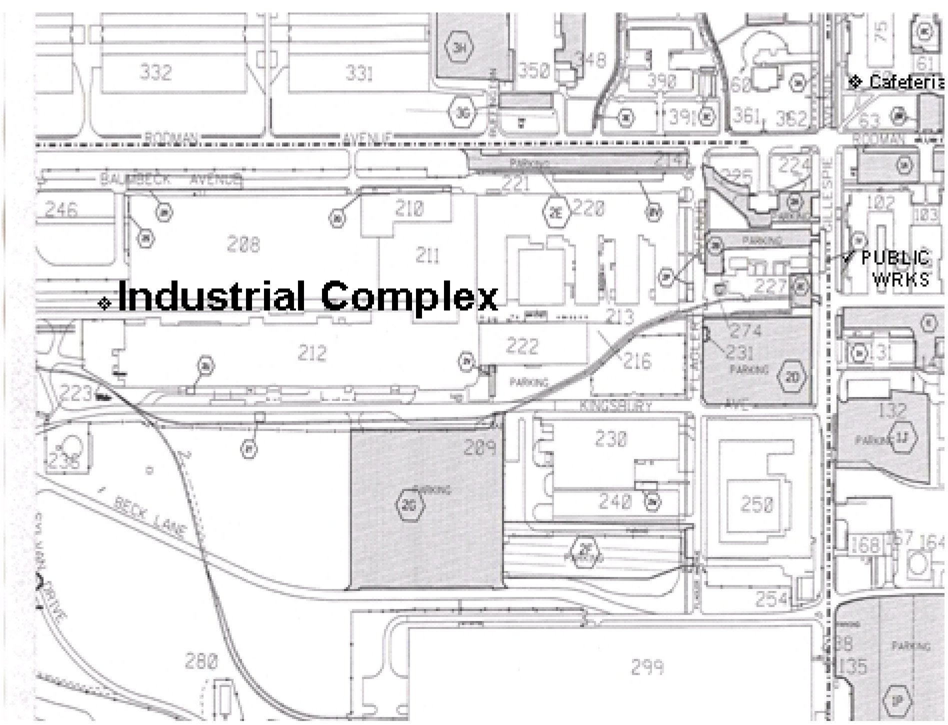

Figure 2. Map of Rock Island Arsenal industrial complex.

Figure 3. The Major Charles B. Kingsbury Manufacturing Center.

The center is reported to be one of the world's largest most modern government manufacturing facilities. It represents a $220 million investment on the part of the government under the Renovation of Armament Manufacturing (REARM) project.

Analysis of Energy Supply, Consumption, and Costs

In 2003, RIA consumed 68,544,000 kWh of electricity with an annual average daily load of 7,825 kW. About 76 percent of the electricity consumed was purchased (51,911,000 kWh costing $2,130,309) at an average cost of 4.10¢/kWh (or about $12/MBtu). The balance was generated by Rock Island's own hydroelectric power plant (16,633,000 kWh). During the same period, the installation used 37,970 MBtu (37,302 KCF) of natural gas, which cost $260,767, at an average cost of $6.87/MBtu. In addition, RIA consumed 23,907 tons of eastern Kentucky coal at $1,204,435 to generate 453,754,000 lb of steam. Average coal cost was about $1.91/MBtu. RIA spent approximately $3,595,511 for energy for the entire year.

The FY05 utility rates for Rock Island Arsenal are listed below:

Electric/Midamerican Energy Rates

$0.03010/kWh, On-peak energy charge, 12 hours/week day (8:00-8:00)

$0.01850/kWh, Off-peak energy charge, 12 hrs/wk day and all weekend

$9.14/kW, Summer demand charge (monthly/no ratchet), Jun-Sep

$4.98/kW, Winter monthly demand charge (8 months)

Natural Gas/MidAmerican Energy Rate

$0.8611/therm, Average gas cost for past year (monthly spot market)

Coal

$129.29/ton, 2004 initial purchase was about $61/ton. Then RIA was billed $126/ton for 7000 tons in late 2004. This relatively high price (in this instance, for 28,000 tons) is “here to stay.”

Steam

$6.7049/klbs, Rate A (Arsenal charge to government tenants. This includes all operation costs of the heating plant - not just the bare coal cost).

Water

$3.3311/kgal, Rate A

Sewer

$4.1501/kgal, Rate A

The plant energy systems convert the kWh of electricity and Btu of fuel into various productive utilities such as compressed air, steam, and shaft power to support various end uses. These annual purchased energy costs and variable unit costs are used as the cost basis of savings (CBoS) for the economic analysis of Energy Conservation Measures (ECMs). Table 2 lists RIA power consumption for FY 2002 and 2003 including electrical, coal and natural gas. For electrical equipment operated 24 hours per day, 7 days per week, 52 weeks per year, the average electric energy cost is $0.02264/kWh or $6.63513/MBtu. The average demand charge for equipment operated year-round is $6.367/kW per month, or $76.4/yr. Taking into consideration of both energy and demand charge, the average electricity cost is $0.03136/kWh. Steam cost of $6.7049/klbs, or $5.615/MBtu is used to calculate heating costs. Saturated steam at 135 psig, 358 °F (1194Btu/lb) is produced via a coal-fired boiler plant.

The Arsenal operates a hydroelectric generator of 3 MW capacity, the output of which is dependent on river head. The natural gas system at RIA operates at a pressure of 30 psig. The local utility (Mid American Energy) uses mercaptan to odorize the natural gas used at RIA.

Unit Cost Calculations and CBoS

Since specific energy conservation measures focus on some type of end-use utility like compressed air, shaft power, lighting, etc. to support a process, the team needed a method to translate reduced consumption at the end use back to lower electricity usage or lower fuel consumption and the associated cost savings. As a result, researchers provided the team with translation formulas to convert incremental end use consumption back to the energy source and ultimately back to dollar cost, called the "Cost Basis of Savings" or (CBoS). Table 3 lists the cost values for an incremental unit of a utility and the underlying equation that derives this amount. The Post Energy Team (PET) may continue to use this table for future ECMs, and to use the formulas to modify the CBoS based on changes in operating assumptions.

Table 2. RIA power consumption summary.

Consumption Type	Cumulative Power Summary (12 Months)			
	Units	**FY02**	**FY03**	
1. Electrical consumption				% Decrease
Month's bill (purchased)	$	2369067	2130309	10.1%
Mega watt hours purchases	MWH	54160	51911	4.2%
Mega watt hours generated	MWH	16305	16663	–2.0%
Total MWH used	MWH	70465	68544	2.7%
Energy consumed	MBTU	240480.7	233924	2.7%
Purchased vs. total usage	%	77%	76%	1.5%
Electric unit cost (avg. purchase cost)	$/KWH	0.043742	0.041038	6.2%
2. Coal consumption				
Month's bill (@ $50.38/ton oct02)	$	1190631	1204435	–1.2%
Coal usage	tons	23633	23907	–1.2%
Energy consumed	MBTU	624336.6	631575.1	–1.2%
BTU content (ave. Apr98 to Nov98)	BTU/lb	13209	13209	
Coal source: eastern Kentucky				
Steam produced/energy consumed	KLB	450137	453754	–0.8%
Degree days: (heating)	HDD	5435	6432	–18.3%
Degree days: (cooling)	CDD	1179	938	20.4%
Coal unit cost	$/KLB	2.64504	2.654378	–0.4%
3. Natural gas consumption				
Month's bill (purchased)	$	122109.1	260766.8	–113.6%
Volume consumed	KCF	31891	37302	–17.0%

Consumption Type	Cumulative Power Summary (12 Months)			
	Units	FY02	FY03	
Energy consumed/volume consumed	BTU/KCF	0.997512	1.017908	–2.0%
Energy consumed	MBTU	31811.64	37970	–19.4%
Gas unit cost	$/KCF	3.828952	6.990693	–-82.6%
4. Total MBTU Consumption		896629	903469.2	–0.8%
5. Total Purchased Energy Cost		3681806	3595511	2.3%

Table 3. Cost Basis of Savings (CBoS).

Utility or cost factor	Derivation and Cost
1. Electricity	Energy cost = $0.03010/kWh on-peak; $0.01850/kWh off-peak Demand charge = $4.98/kW-month winter; $9.14/kW-month summer Average $0.03136/kWh including both energy and demand. $275/kW-year (combined energy and demand) = 1 kW used for 8,760 hrs/year $76.4/kW-year (demand only)
2. Horsepower	1 hp x 0.746 kW/Hp x 8760hrs/yr x $0.03136/kWh = $205/hp-yr
3. Natural gas	$8.611/MBtu ($8.77/kCF; energy content 1,018Btu/kCF)
4. Coal	Eastern Kentucky, 13209 Btu/lb $129.29/ton, $4.894/MBtu
5. Steam	135 psig, 358 °F saturated steam, 1194Btu/lb $6.7049/klb (Arsenal charges to government tenants), $5.615/MBtu
6. Water and sewer	Water = $3.3311/kgal, Rate A Sewer= $4.1501/kgal, Rate A

Team and Schedule

The second phase site study took place over a 5-day period between Monday, 29 November and Friday, 03 December 2004. Table 4 lists the team members and their affiliations. Table 5 shows how the 5-day work was organized by time, activities, and location to ensure that all of the areas in the scope of work were covered and that the information collection, brainstorming sessions, and briefings to the management were built-in to the RIA personnel busy schedules. Figures 4 and 5, respectively, show the kickoff meeting and exit briefing.

Table 4. PEOA participants list.

Rock Island Arsenal		
Patrick Van Acker	Norman Hatcher	Bradley Niles
David Bailey	Tim Heim	David Osborn
Mark Benes	Mike Hofer	Mark Orobushevich
Timothy Bolyard	Ronald Kessel	Robert Pettit
Stephen Clark	David Langum	Jay Richter
Gary Cook	Kentley Loewenstein	Dennis Ryan
Michael Fitzgerald	Scott Macomber	Jerome Sechser
Charles Gerdes	Thomas Michoski	Cathy Sonnenberg
Jerry Golden	Gary Milefchik	Charles Swynenberg

Rock Island Arsenal		
Hugh Halverson	Floria Moore	James Thompson
Dane Hansen	Curtis Morehead	Benny Wild
Sue Harrington	Scott Naeseth	Richard Wingert
OACSIM	**ERDC-CERL**	**University of IL at Chicago**
Dave Williams	James Hay	Mike Chimack
	Mike Lin	Robert Miller
ETSI	Alexander Zhivov	Andrew Sheaffer
Walt Smith		
VEA	**CBF&K**	**Palm International**
Alfred Woody	Patrik Bergvall	Terry Hutchins
	Curt Bjork	John Fett

Table 5. Level II assessment schedule.

Monday	**(29 Nov 04)**
10:00-11:30	Kickoff Meeting (Dave Osborn, RIA, Alexander Zhivov, CERL) (Figure 2)
	JMTC Conference Room, Building 210, Room 203
11:30-12:30	Lunch
12:30-15:30	Painting Shop Assessment
	HVAC, Building Envelope
	Welding
14:30-16:30	Brainstorming session with responsible operational staff
Tuesday	**(30 Nov 04)**
7:30-15:30	Painting
	HVAC, Building Envelope
Wednesday	**(01 Dec 04)**
7:30-15:30	Plating Shop Assessment
	Heat Treatment Shop Assessment
	HVAC, Building Envelope
	Boiler Plant
Thursday	**(02Dec 04)**
7:30-15:30	Machining
	Foundry
	HVAC, Building Envelope
Friday	**(03 Dec 04)**
8:00-10:00	Exit Briefing (Assessment Team)

Figure 4. PEOA Phase 2 kickoff meeting, 29 Nov 04

Figure 5. PEOA Phase 2 exit briefing, 03 Dec 04.

Current Situation at Rock Island Arsenal

The Arsenal's plating shop was built in the late 1980s. Improvements in technology have occurred since then which will conserve energy and improve indoor air quality. The chrome plating tanks currently operate with a dual draw ventilation method that takes a very high volume of air flow through a scrubber system where toxic vapors are stripped out and collected. The system basically operates at one speed and each scrubber serves a number of tanks. These systems require a very high volume of make-up air which results in great use of energy to keep the facility warm in the heating season.

Most of the Arsenal's painting areas are currently open to the rest of the industrial space and use a high volume of air changes to draw the painting mists out. Some vapors still get into the rest of the facilities. A lot of energy is used for make-up air in the heating season.

The ventilation system in the weld shop includes extraction arms with pickup vents. The various work stations are left on all the time and the exhaust system runs 100 percent even if only one station is in use. Also, the HVUs for the weld system run continuously at 100 percent and the HVAC system runs un-balanced in that shop with respect to supply and exhaust air.

Building envelope improvements are needed in two shop buildings. In one, the existing steel sash windows have not been maintained and are very expensive to replace because of historical requirements. The window operators are in poor condition and numerous windows are open as much as one inch in this four story building. The HVAC improvements made in the 1990s will provide adequate ventilation. Thus the majority of windows can be permanently sealed and the operators removed. In the other building, several overhead doors separate heated space from unheated space. Replacing the overhead doors with high-speed coil type doors will reduce significant heat loss in the winter.

The cooling tower in the forge shop serving three air compressors currently runs continuously even while there is no demand for compressed air. Simple thermostat controls can provide demand based operation of the cooling tower.

Installation of task lighting in various shops will eliminate some ongoing concerns about inadequate lighting. The solution in the past has been to install more overhead lighting when a temporary mission gets set up. The addition of adjustable T5 fixtures will provide higher light levels in a manner that can be reconfigured as missions change.

The Arsenal industrial center space and mission affected by this project was largely unaffected by BRAC (Base Realignment and Closure) 2005.

3 Level II Analysis Results

This chapter provides results of the Level II analysis, grouped by categories listed in Table 6.

Table 6. Evaluated processes and systems.

Processes		Systems	
1. Plating (PT)	4. Machining (MC)	7. Building Envelope (BE)	10. Boiler Plant (BP)
2. Painting (PN)	5. Foundry (FD)	8. Building HVAC (BH)	
3. Heat Treatment (HT)	6. Welding (WD)	9. Lighting (LT)	

Plating Area

The Electroplating Area is located in the Building 212. One hundred eighteen plating tanks are used to apply chrome, nickel, cadmium, and copper, and to galvanize, parkerize, anodize, and apply oxide finishes. The production processes emit different acid mists, gases and steam. Plating tanks are equipped with the bilateral exhausts with downward plenums that capture contaminants. Water used in plating operations is treated in a reverse-osmosis system housed in the basement. Chemicals for the plating operations are supplied by a gravity feed system. Automated controls properly mix the chemicals, achieve and maintain correct temperatures, etc.

The tanks, organized into 12 separate lines, are of either stainless steel, mild steel, or brick-lined construction. There are a total of 16 different tanks styles, 10 of which are of brick-lined construction, while the remaining six are of stainless or mild steel construction. The brick-lined tanks all have a bonded liner that assists the brick in insulating the contents, retaining heat added to the tanks. A small number of the stainless and mild steel tanks have a thin layer of insulating board, while the vast majority does not have any sort of insulation other than the metal of the tank.

Some operations at the Rock Island Arsenal Plating Shop require that the solutions in the tanks be heated. This heating is accomplished by a combination of heat exchangers and pile coils that are installed in the tanks. These exchangers and coils, heated by steam, heat and maintain the solutions at elevated temperatures. The tanks are kept at these elevated temperatures ranging from 130 °F to 255 °F throughout the year, whether plating operations are taking place or not. Of the approximately 118 tanks in the plating shop, 18 were found to have exterior tank temperatures in excess of 80 °F. As the average ambient air temperature of the Rock Island Arsenal Plating Shop is 78 °F, the tanks are radiating heat to the surrounding air, resulting in energy losses such that more steam is required to maintain the tanks at their desired temperatures.

The plating shop (Figure 6) is kept under negative pressure with the make-up air at a rate of approximately 15 air changes per hour coming from adjacent production areas. Only a small percent of the plating tanks are used, while the extraction system is operated at 100 percent capacity. This operation requires ~500,000 cfm of exhaust and the same amount of make-up air systems operation.

Figure 6. Plating operations in Building 212.

Recommendations for Plating Operation

PL#1: Install Emission Elimination Devices (EED) on Chrome Plating Tanks

Existing Conditions

The existing "open" chrome plating tanks require conventional fume exhaust capture and wet scrubbers to reduce hazardous hexavalent chrome exposure in the work area and to reduce outside chrome emissions to the atmosphere. While there is no reason to be concerned about past or current RIA worker exposure or air emissions, new "proposed" worker exposure limits are under consideration to be reduced from 52µg/m^3 to 1µg/m^3*

The performance of the existing open hard chrome tank operations can be greatly improved by totally enclosing the tanks with highly effective, easy to use proven tank cover technology. The financial benefits of this technology are:

1. Significant energy and cost reduction by totally eliminating the pull-pull, down-draft tank exhaust ventilation and associated energy operating cost of the scrubbers (exhaust fans and pumps)
2. Reduced plating shop winter make up air energy and the corresponding winter heating energy by eliminating scrubber exhaust air
3. Eliminating routine scrubber maintenance cost and extremely high major scrubber overhaul/rebuild cost
4. Elimination of the environmental cost currently required for the hazardous scrubber waste processing and disposal costs (processing labor and disposal costs)
5. Reduction of chrome chemical costs due to growth, reduced hexavalent chrome/solution evaporation
6. Further worker exposure protection from hexavalent chrome.

Solution

Descriptive Scope of Work

This recommendation is being proposed as a two-phased approach to: (1) fully demonstrate the tank enclosure performance as judged by the RIA management team prior to full implementation on all chrome required tanks, and (2) not reduce the plating shop's chrome capability during the full retrofit to all covered tanks.

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* RIA's chrome plating operations are currently in compliance with work place safety and environmental Cr+6 requirements (OSHA 100µg/m3, ACGIH 52µg/m3). However, proposed new ACGIH chrome limits may reduced the requirement from 52µg/m3 to 1µg/m3 (worker 8 hour TWA Personnel Exposure Limits, PEL). The proposed limits are currently under public comment proposed 52 to 1 reduction as extreme and unnecessary. RIA may currently have a problem with 1µg/m3 based on limited sampling showing 1 to 6µg/m3 (reference Gary Heitman and Carol Highborn). The proposed totally enclosed Cr Palm® covers would be expected to greatly reduce the existing Cr exposure levels.

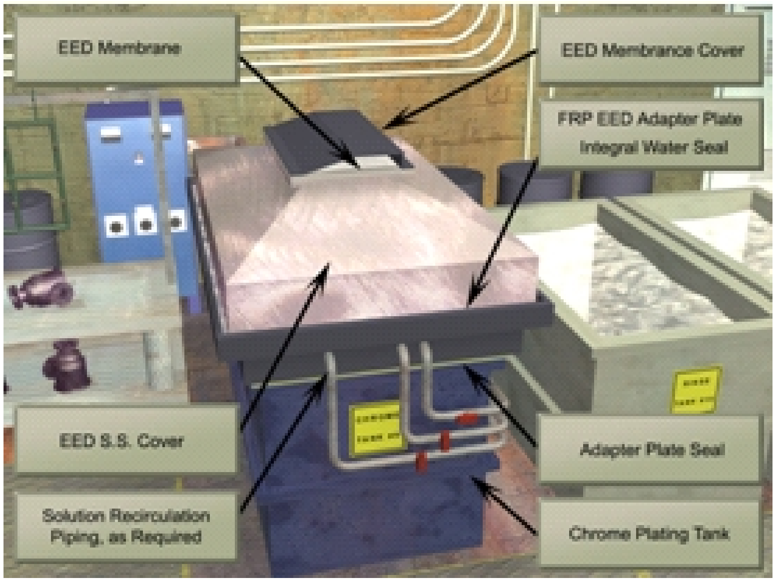


Figure 7. Emission elimination device developed by Palm International.

Phase 1: Install two (2) "new" chrome tanks with Palm® covers (Figure 7) in the existing, unused phosphate area to demonstrate the "proof of concept" to the satisfaction of RIA personnel. No tank exhaust ventilation or scrubber is required with the Palm covers. The two new tanks will require new auxiliary cooling and heating supply systems and should be sized to provide higher tank productivity as needed.

The Palm® EED (Emission Elimination Device) have been successfully demonstrated for more than 10 years and permitted in Los Angeles and San Diego, CA emissions/OSHA regulatory environment, one of the most critical environments in the U.S.

Phase 2: Install Palm® covers on the remaining 13 chrome tanks. This will require re-arrangement of the four rows of tanks into three rows with heating and cooling auxiliaries to allow space for the Palm® covers to be hinged along the back of the tanks. The existing three (3) scrubbers can be decommissioned based on the successful evaluation from Phase 1. Supplemental funding through ESTCP (Environmental Security Technology Certification Program) may be possible as an energy/environmental research demonstration project.

Savings

The following data and assumptions are used to calculate the projected savings and cost:

A. Energy savings assumptions and data

1. Scrubber exhaust fans (3@95hp, nameplate) operating at 79hp each (approximately 30,000cfm@ 12 in. o.k.). Operating fan load is approximately 60 kW
2. Scrubber recirculation pumps (3) are 20hp at 90% loaded and 90% efficiency equal to 20hp load or approximately 15 kW
3. Evaporative heat losses from the chrome tank at 130 °F are 500 Btu/hr/sq ft
4. Steam heat energy cost $5.615/MBtu or $6.7049/klbs steam, this is the rate Arsenal charges to government tenants. This includes all operation costs of the coal heating plant.
5. Electricity energy cost is 2.264¢/kWh
6. Scrubber operation is 156hrs/week x 52 weeks/yr = 8,100 hours
7. Plating shop make-up air flow reduction is equal to four make-up fans at 21hp or 62 kW for 8,100 hours/year
8. Avoided winter heating of make up air (RIA average winter temperature 34 °F) at 85,000cfm

B. Scrubber Maintenance

1. Major overhaul: It is noted that one of the three scrubbers recently required approximately $600,000 for major maintenance. Continued use of the scrubber systems are estimated to require $600,000/scrubber every 15 years for long interval major overhaul (materials + labor)
2. Routine maintenance:

    a. Labor: Scrubbers average 10 percent of one pipe fitter/year and 5% of one electrician/year ($60 k/work-year for salary, benefits and overtime)
    b. Maintenance materials: equal to scrubber maintenance labor

3. Materials and labor for scrubber operation:

    a. materials (Chrome, H_2SO_4, etc)
    b. Environmental costs for scrubbers
    c. Hazardous Cr wastewater = $5k/year
    d. Stack monitoring = $5K for all three stacks

C. Operating and Maintenance Cost for Palm® covers (per Palm®, Terry Hutchins)

1. Yearly membrane cost @ $300/tank
2. Evacuation filter replacement @200/tank
3. Evacuation system power costs @ 2hp/tank, 50% loaded, 1 hour/day, 300days/year
4. Maintenance labor @ $200/tank

Savings from 15 Covered Tanks Without Scrubbers:

A. Energy Savings w/o Scrubbers

1. Scrubber exhaust fan energy = three fans x 79 hp each (measured) x 0.746 kW/hp x 8,100hr/yr = 1,432,096 kWh/year
2. Scrubber pumps = three pumps x 20hp x 0.746KW/hp x 8,100hr/yr = 362,556 kWh/year
3. Chrome tank surface evaporative heat loss = 15 tanks x 25sqft/tank x 500Btu/hr/sqft x 8,100hr/yr / 10^6 MBtu = 1,519 MBtu/year
4. Avoided shop make up air=4 make up fans x 21hp/fan x 0.746 kW/hp x 8,100hr/yr = 507,578 kWh/year
5. Avoided winter heating of make up air (RIA average winter temperature 36.6 °F) at 85,000cfm savings = 1.08 (Btu/°F*cfm*hr) x (72-36.6) °F x 85,000cfm x (8100Hr x 5/12) = 10,968 MBtu/yr.

B. Avoided Scrubber Annual "Level zed" Maintenance Cost per Year

1. Major overhaul every 15 years = three scrubbers x $600,000/15 years per scrubber = $120,000/year
2. Avoided routine annual scrubber maintenance cost = (10% of one pipe fitter + 5% of one electrician/instrument) x $60,000/work-year = $9,000/year
3. Avoided routine annual maintenance materials = same as scrubber maintenance labor = $9,000/year
4. Scrubber operating labor and materials cost = labor @ 20% x $60,000/year + $10,000/year (chrome + acid) = $22,000/year
5. Environmental cost = chrome solid waste disposal ($5,000/yr) + stack monitoring ($5,000/yr) = $10,000/yr

C. Less Operating and Maintenance Cost for 15 Palm® Covers

1. Membrane replacement = 15 x $300/yr = $4,500/yr
2. Evacuation filter replacement = 15 x $200/yr = $3,000/yr
3. Evacuation fan power = 15 x 2hp x 0.746 kW/hp x 50% loaded x 1hr/day x 300 days/yr = 3,357 kWh/yr
4. Maintenance labor = 15 covers x $200/yr = $3,000/year

Cost Estimate Calculations

Phase I: Install two (2) "new" chrome plating tank systems by Palm® including (turnkey by Palm®):

1. 2 Corporeal lined 8-ft h x 4-ft w x 6-ft d tanks = $18K
2. Bussing (3000amp) w/ rectifiers = $14K

3. Associated heating/cooling with controls = $10K
4. Palm® covers with auxiliary systems = $90K

Total estimated installed cost for Phase I(as itemized in Table 7): $153.5K

Table 7. Total estimated installed cost for Phase I.

Item	Unit	Quantity	Unit Cost	Total Cost	Notes
Corporeal lines plating tanks 8-ft high x 4 ft wide x 6 ft deep	EA	2	$9,000	$18,000	
Bussing (3000amp) w/ rectifiers	EA	1	$14,000	$14,000	
Associated heating/cooling with controls	EA	1	$10,000	$10,000	
Palm® covers with auxiliary systems	EA	2	$45,000	$90,000	Average of 200 sq. ft./tank
Estimated contract cost				$132,000	
Contingency percent (10%)				$13,200	
Subtotal				$145,200	
Supervision, inspection and overhead (5.7%)				$8,280	
Total request				$153,480	
Total request (rounded)				$153,500	
Installed equipment-other appropriations				$0	

Phase II: Rearrange chrome plating tanks and auxiliary systems in existing areas to provide space for the addition of Palm® covers on 14 tanks in thee instead of four rows.

Installed cost: = 13 tanks x $45K/tank: $585K

Rearrange existing chrome plating tanks = 13 tanks x $10K/tank = $130K

Total estimated installed cost for Phase II as itemized in the Table 8 = $831.3K

Table 8. Total estimated installed cost for Phase II.

Item	Unit	Quantity	Unit Cost	Total Cost	Notes
Rearrange existing chrome plating tanks	EA	13	$10,000	$130,000	
Palm® covers with auxiliary systems	EA	13	$45,000	$585,000	Average of 200 sq. ft./tank
Estimated contract cost				$715,000	
Contingency percent (10%)				$71,500	
Subtotal				$786,500	
Supervision, inspection & overhead (5.7%)				$44,830	
Total request				$831,330	
Total request (rounded)				$831,300	
Installed equipment-other appropriations				$0	

PL#1A: Install EED on Two Chrome Plating Tanks

It is proposed to pursue Phase 1 by installing EED on two chrome tanks first and perform Life Cycle Cost Analysis (LCCA) of this measure.

Although savings for fan and pump energy can only be realized when all tanks are retrofitted, a fraction (2/15) of the savings is taken credit for here. The cost for electricity for this project is $.02264/kWh since operations are nearly 24 hours 7 days a week.

Scrubber exhaust fan energy = (2/15) x three fans x 79 hp each (measured) x 0.746 kW/hp x 8,100hr/yr = 190,946 kWh/yr

Scrubber pumps = (2/15) x three pumps x 20hp x 0.746 kW/hp x 8,100hr/yr = 48,341 kWh/yr

Chrome tank surface evaporative heat loss = (2/15) x 15 tanks x 25sqft/tank x 500Btu/hr/sqft x 8,100hr/yr = 203 MBtu/yr

Avoided shop make up air= (2/15) x 4 make up fans x 21hp/fan x 0.746 kW/hp x 8,100hr/yr = 67,677 kWh/yr

Avoided winter heating of make up air at 85,000cfm savings = (2/15) x 1.08 (Btu/°F*cfm*hr) x (72-36.6) °F x 85,000cfm x (8100Hr x 5/12) = 1462 MBtu/yr

Avoided Scrubber Annual "Level zed" Maintenance Cost per Year

Major overhaul every 15 years = three scrubbers x $600,000/15 years per scrubber = $120.0K/year

One overhaul every 5 years = $600K x 2/15 = $80K at 5, 10, and 15 years

Avoided routine annual scrubber maintenance cost = (10% of one pipe fitter + 5% of one electrician/instrument) x $60K/work-year = $9.0K/year x (2/15) = $1200/yr

Avoided routine annual maintenance materials = same as scrubber maintenance labor = $9.0K/year x (2/15) = $1200/yr

Scrubber operating labor and materials cost = labor @ 20% x $60K/year + $10K/year (chrome + acid) = $22.0K/year x (2/15) = $2993/yr

Environmental cost = chrome solid waste disposal ($5K/yr) + stack monitoring ($5K/yr) = $10K/yr x (2/15) = $1333/yr

C. Less Operating and Maintenance Cost for 2 Palm® Covers Membrane replacement = 2 x $300/year = $600/yr

Evacuation filter replacement = 2 x $200/year = $400/yr

Evacuation fan power = 2 x 2hp x 0.746 kW/hp x 50% loaded x 1hr/day x 300 days/yr = 448 kWh/yr

Maintenance labor = 2 covers x $200/yr = $400/yr

Based on the above savings calculations, a LCCA is then performed using a software program BLCC5 (updated April 2005 version). BLCC5 is developed by NIST (National Institute of Standards and Technology, U.S. Department of Commerce).

Note for each LCCA performed, some notes are included about the particulars of the ECM relating to the LCCA. Note that while electricity is normally charged in units of kilowatt hours, BLCC5 reports convert this to MBtu. In addition, ECIP guidance requires that project documentation be in metric units in support of goals established under Executive Order 12770 "Metric Usage in Federal Government Programs" dated 25 July 1991. Also — although the input files in running BLCC5 indicate the location used was "U.S. Average," the true local costs of fuel are used.

The input file to run BLCC5 program is presented in Appendix A. LCCA report (ECIP output files) for each ECM is presented in Appendix B.

The data in Table 9 summarize the Phase 1 economic benefits.

Table 9. Summary of ECM Phase 1 economic benefits.

Net Savings, Cost and Payback	Economics
Net operating and energy savings (k$/yr)	$33.6
Capital cost (k$)	$153.5
Simple payback (years)	4.6
LCCA Results Summary	
First year savings	$33,556
Simple payback period (in years)	4.57
Total discounted operational savings	$589,811
Savings to Investment Ratio (SIR)	3.84
Adjusted Internal Rate of Return (AIRR)	10.17%

PL#1: Install EED on All Chrome Plating Tanks (Phase 1 followed by Phase 2)

After complete Phase 1 study, a decision can then be made if the Phase 2 work should be pursued. Life Cycle Cost Analysis (LCCA) results of this measure (summarized below) can be found in Appendixes A and B.

LCCA Results Summary

First year savings	$251,673
Simple payback period (in years)	3.91 years
Total discounted operational savings	$4,423,640
Savings to Investment Ratio (SIR)	4.49
Adjusted Internal Rate of Return (AIRR)	11.04%

PL#2: Control Airflows and Steam Heating in Plating Shop

Existing Conditions

The plating shop is today operated 24 hours per day, 7 days/week. Normal operations are for 5 days/week. The plating shop is ventilated so that the indoor air is exchanged close to 13 times per hour. This is approximately 500,000 cam. Exhaust air from chrome plating tanks and other tanks is taken through scrubbers that clean the exhaust air before released to the atmosphere. There are 11 scrubbers, each operating vs. one or several tanks. Scrubbers are switched on and off manually. They are normally on when the plating shop is running. A control system calculates the exhaust airflow and starts a sufficient number of Mauls to make the shop slightly under-pressured. It works in theory, but not in practice; the plating shop is suffering from a positive pressure. Concerns have been found regarding the hazards related to pollutants and aggressive chemicals leaving the plating shop and entering the welding shop in Building 212.

The control system does not work properly. Mauls have filters that are getting dirty, the static pressure drop increases over time and the airflow is reduced. Thus the negative pressure increases. At certain outdoor temperature conditions the control system shuts down ventilation in the entire plating shop, which is a serious fault. (Installation personnel have not yet discovered the cause.)

Steam heating control, for coils in Mauls, are not in accordance with today's standards. The steam valves are operated on/off and not modulated. This increases energy use. The personnel in the plating shop also complain over overheated space, resulting from the poor steam control. During the audit in Phase 1 (June 2004, with 80 + °F), it was discovered that one studied heating coil was hot, heating the surrounding area.

Solution

We suggested a solution based on the situation where the three scrubbers for chrome tanks have been taken out of operation as a result of the proposed measure to cover the chrome tanks with sealed lids from PALM International.

For the remaining equipment for exhaust and Mauls in the Plating shop we propose:

- Install Vedas on eight scrubber fans, all other exhaust fans (for tank pit exhaust and other non-scrubbed exhaust), and for one of the MAU fans. Vedas for exhaust fans shall have three positions; off / half flow (approximately, could be fine-tuned) / full flow. Vedas for scrubbers shall have the same three positions but the full flow mode should be connected to a timer allowing whatever plating time is needed for every single operation. A new control system should be installed to replace the old one. Pressure sensors inside and outdoors shall be installed and connected to the new control system. The system shall operate Mauls (with and without Vedas) to keep the plating shop under a small negative pressure. Personnel operate the exhaust air units in accordance with the operations to be done. Tanks not used should be on half flow or, if possible, they should be left off.

- Modulating steam valves were originally (in Phase 1) suggested to be installed and incorporated in the new control system. We do not believe that this is necessary anymore. A proper check of the heating coils every spring could easily reveal the steam valves that are not closing and that need maintenance. Regular visits to the Mauls should be mandatory.

Savings

Based on the assumptions that the plating shop can go from more or less continuous ventilation at full speed to half flow during two thirds of the time the electric energy savings have been calculated to:

For scrubber exhaust fans:

0.746kW/Hp x (345Hp x 1 x 8760Hr) – ((345Hp x .5 x (8760Hr x 2/3) + (345Hp x (1/3) x 8760)) = 751,520kWh

For other exhaust fans:

(115kW x 1 x 8760Hr) – ((115Hp x .5 x (8760Hr x 2/3) + (115kW x (1/3) x 8760Hr)) = 335,800 kWh

For Mauls:

210 kW: (210kW x 1 8760Hr) – ((210kW x .5 x (8760Hr x 2/3) + (210kW x (1/3) x 8760Hr)) = 613,200 kWh

The value of the steam savings, not having to heat all the outside air that is heated today amounts to:

1.08 (Btu/°F*CFM*hr) x (72-36.6) °F x 85,000cfm x (1/2 x 2/3 + 1/3) x 8760Hr/yr x 5/12 = 7,908 MBtu/yr.

Additional savings come from wastewater savings and IAQ. These have not been calculated. We have not calculated on any operational mode where the fans are totally shut down in the calculations. We believe that it is possible to have substantial amount of time with several fans and MAUs being completely shut down. This will increase energy related savings.

Investments

Investment costs include VFDs for pump and fan motors as well as new control system, pressure control sensors, and new operator switches for scrubber fans (Table 10).

Total estimated investment = $212K

Table 10. Total estimated investment.

Item	Unit	Quantity	Unit Cost	Total Cost
15 HP VFD	EA	2	$3,550	$7,100
20 HP VFD	EA	1	$4,725	$4,725
25 HP VFD	EA	1	$5,675	$5,675
50 HP VFD	EA	1	$10,100	$10,100
60 HP VFD	EA	1	$11,400	$11,400
75 HP VFD	EA	1	$14,700	$14,700
100 HP VFD	EA	2	$15,300	$30,600
Other misc. exhaust fans 115 kW	KW	115	$200	$23,000
Controls	EA	1	$70,000	$70,000
Installation preparation	EA	1	$5,000	$5,000
Estimated contract cost				$182,300
Contingency percent (10%)				$18,200
Subtotal				$200,530
Supervision, inspection & overhead (5.7%)				$11,430
Total request				$211,960
Total request (rounded)				$212,000
Installed equipment-other appropriations				$0

LCCA results Summary

First year savings	$82,903
Simple payback period (in years)	2.56 years
Total discounted operational savings	$1,244,829
Savings to Investment Ratio (SIR)	2.56
Adjusted Internal Rate of Return (AIRR)	12.53%

PL#3: Insulate Hot Plating Tanks and Rinse Tanks

Existing Conditions

The Plating Shop at the Rock Island Arsenal has approximately 118 tanks used to apply various coatings to parts or to support such operations. The tanks, organized into 12 separate lines, are of either stainless steel, mild steel, or brick-lined construction. There are a total of 16 different tanks styles, 10 of which are of brick-lined construction, while the remaining six are of stainless or mild steel construction. The brick-lined tanks all have a bonded liner that assists the brick in insulating the contents, retaining heat added to the tanks. A small number of the stainless and mild steel tanks have a thin layer of insulating board, while the vast majority does not have any sort of insulation other than the metal of the tank.

Of the approximately 118 tanks in the plating shop, 18 were found to have exterior tank temperatures in excess of 80 °F. These 18 tanks were identified and numbered as shown in Figure 8. As the average ambient air temperature of the Rock Island Arsenal Plating Shop is 78 °F, the tanks are radiating heat to the surrounding air, resulting in energy losses as more steam is required to maintain the tanks at their desired temperatures. Tank heating is accomplished by a combination of heat exchangers and pile coils that are installed in the tanks. These exchangers and coils, heated by steam, heat and maintain the solutions at elevated temperatures. The tanks are kept at these elevated temperatures ranging from 130 °F to 255 °F throughout the year, whether plating operations are taking place or not.

Solution

This recommendation consists of adding insulation to 18 tanks in Rock Island Arsenal Plating Shop. The goal is to reduce the amount of steam required to maintain the tanks at the desired temperatures by installing insulation on the sides and bottoms of the tanks. This will result in decreased heat losses and a consequent reduce energy consumption. This work is based on a comprehensive engineering study of the plating tanks in the Plating Shop and the premise that reducing the heat losses of the tanks will result in reduced steam usage. As the heated plating tanks are kept in such condition 8,760 hours per year, even a small difference between the exterior temperatures of the tanks and the surrounding ambient air will result in significant energy savings. The proposed modifications will last for the remaining life of the tanks.

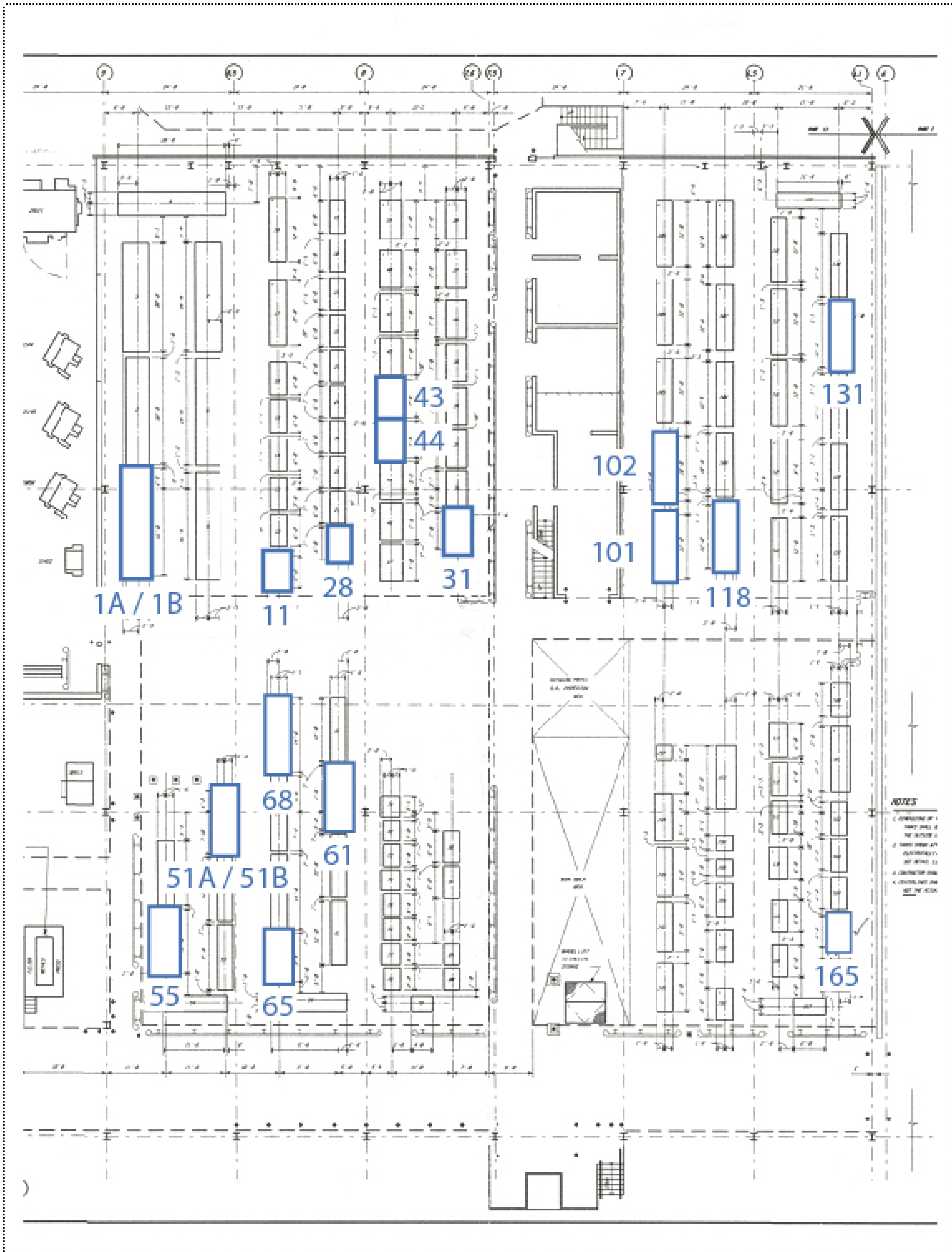


Figure 8. Plating shop drawing with 18 to-be-insulated tanks numbered.

The project will begin by measuring and cutting the insulation to fit along the sides of the tanks. The insulation will then be positioned and bonded to the sides of the tanks using liquid adhesive.

Savings

Table 11 lists the amount of prevented heat loss for each insulated tank.

Table 11. The amount of prevented heat loss for each insulated tank.

No.	Tank	Tank Style*	Substance	Tank Tempe rature (°F)	Ambient Air Temperature (°F)	Heat Loss (Current) [Btu/hr]	Heat Loss (Proposed) [Btu/hr]	Prevented Heat Loss [Btu/hr]
1	55	13	Water	175	78	37,840	11,762	26,078
2	1A	11	Water	142	78	21,819	9,201	12,618
3	1B	11	Water	132	78	18,410	7,763	10,646
4	110	5	Water	164	78	6,804	5,089	1,715
5	44	12	Water	198	78	34,835	14,762	20,074
6	43	12	Dichromate sealer	168	78	26,127	11,071	15,055
7	131	5	Water	181	78	8,149	6,095	2,054
8	31	12	Cleaner	166	78	22,189	8,388	13,801
9	68	14	Chromate sealer	160	78	36,513	10,794	25,719
10	51A	17	Black oxide	88	78	322	252	69
11	51B	17	Black oxide	255	78	9,583	7,278	2,304
12	61	13	Phosphate	164	78	33,548	10,428	23,120
13	65	12	Phosphate	181	78	31,655	10,887	20,768
14	101	5	Chrome	130	78	4,114	3,077	1,037
15	102	5	Chrome	130	78	3,491	2,626	864
16	28	12	Water	129	78	13,263	5,951	7,313
17	11	12	Electro cleaner	158	78	17,965	7,211	10,754
18	165	3	Water	181	78	4,444	3,417	1,027
Totals						331,068	136,052	195,016

***** As specified in the RIA as-built drawings on file at Public Works.

Using the resulting 195,016 Btu/hr and the annual energy savings are as follows:

$$195{,}016 \text{ Btu/hr} \times 8{,}760 \text{ hr/yr} = 1{,}708 \text{ MBtu/yr}$$

Note that if this recommendation is adopted along with the recommendation to shut down the plating tanks on weekends, the savings realized will be less due to the decreased number of hours that these tanks will be in operation.

If this project is not accomplished, the stainless and mild steel tanks will continue to consume more energy than is necessary. The tanks will not degrade, but they will not achieve their optimal performance.

Investments

The data listed in Table 12 show that this could be done at an estimated cost of $101,000.

Payback

The simple payback of this project is calculated to be $101,000/$9,590/yr = 10.5 years, based on the first cost and installation of the insulation, as compared to the energy savings that is expected to result.

Table 12. Investment cost estimates.

Item	Unit	Quantity	Unit Cost	Total Cost	Notes
Plating shop tanks (18 Total)	18				
Clean tank exteriors (sides and bottoms)	EA	1	480	$8,640	8 hours per tank
Cut and install insulation	EA	1	1,920	$34,560	32 hours per tank
Insulation	EA	200	12	$43,200	Average of 200 sq. ft./tank
Adhesive	EA	1	24	$432	1 gallon adhesive per tank
Estimated contract cost				$86,832	
Contingency percent (10%)				$8,683	
Subtotal				$95,515	
Supervision, inspection & overhead (5.7%)				$5,444	
Total request				$100,959	
Total request (rounded)				$101,000	
Installed equipment-other appropriations				$0	

LCCA results Summary

First year savings	$9,590
Simple payback period (in years)	10.53 years
Total discounted operational savings	$143,375
Savings to Investment Ratio (SIR)	1.42
Adjusted Internal Rate of Return (AIRR)	4.82%

PL#4: Improve Scheduling for Plating Operations so that Plating Shop Production Can Be Planned and Made More Effective

Existing Conditions

At the present time, there is no chance for the plating shop to know which type of jobs and to what extent that will arrive during the next hour, day or week. There exist no possibilities to plan for how to take care of the workload since the workload is constantly unknown. The Plating Shop is supposed to be up and ready to do whatever plating that “MIGHT” be necessary whenever needed. Arriving pieces to be plated or treated in other processes are normally also always very urgent, i.e., the pieces normally already should have been sent back yesterday. This causes enormous energy bills, with all tanks at the right temperature, with the entire ventilation running, all lighting on, all pumps and cleaning systems always in operation.

Solution

Phase 1: Incorporate the Plating Shop in the scheduling of what is to be done and when within the industrial facilities of the Arsenal. We are pretty sure that people that plan and take responsibility for the Arsenals commitment and orders know exactly which types of operations that need to be done on every vehicle, howitzer etc. that comes in to the Arsenal for retrofitting or repair. Also, the total workload must be known to some extent in advance, allowing for planning of operations and scheduling of resources and manpower.

New information, Phase 2: Even though there are people working with planning and scheduling, and also using appropriate software to handle the complex issues of planning industrial manufacturing at the Rock Island Arsenal, the systems do not work. Plans are not updated with respect to urgent deliveries that affect all plans. This means that plans and schedules are never up-to-date. Therefore it is not meaningful to also incorporate the plating shop into a planning tool that does not show the real world data, just the planned actions that are no longer effective.

Still valid: If the Plating Shop would know in advance (1 day or 1 week in advance) what to do with which piece of equipment they could plan on which tanks to keep warm, when they would have to warm up tanks that from energy and IAQ reasons have been shut down as soon as there is no work to be done in them etc. If there would also be a certain time allowed for the plating operations, let’s say that arriving material should be plated and delivered within 48 hours, then the plating shop could be run very smoothly and with very low energy costs, especially in combination with other suggested measures regarding ventilation in the plating shop.

Savings

Better scheduling procedures can save a lot of money for the Arsenal in the following areas:

- Energy savings in the plating shop itself (tank heating, pumps, fans, steam coils).
- Reduced waiting costs in production units after the plating shop (machining, painting, assembly, etc.).

- Maintenance can be planned and also be done by plating shop personnel if they do not sit and wait for work maybe coming in.
- Reduced running time for equipment prolongs lifetime and reduces maintenance costs.
- Reduced costs for treatment of wastewater.
- Reduced costs for chemicals.
- Reduced labor costs if sufficient number of people work in accordance with workload.

Further Action

This proposal is dropped. It makes no sense unless planning and scheduling (as presented in the software results) meet reality.

PL#5: Allow Some Hot Plating and Rinse Tanks to Cool Down at Certain Times

Existing Conditions

The Plating Shop at the Rock Island Arsenal has 118 tanks used to apply various coatings to parts or to support such operations. Of the 118 tanks, 18 were found to have exterior tank temperatures in excess of 80 °F. This heating is accomplished by a combination of heat exchangers and pile coils that are installed in the tanks. These exchangers and coils, heated by steam, heat and maintain the solutions at elevated temperatures. The tanks are kept at these elevated temperatures ranging from 130 to 255 °F throughout the year, whether plating operations are taking place or not. As the average ambient air temperature of the Rock Island Arsenal Plating Shop is 78 °F, the tanks are radiating heat to the surrounding air, resulting in energy losses as more steam is required to maintain the tanks at their desired temperatures.

Solution

This recommendation consists of shutting down the constantly heated 18 tanks in Rock Island Arsenal Plating Shop during the weekend hours. This action will require less steam to heat the plating tanks, resulting in energy savings.

This work is based on a comprehensive engineering study of the plating tanks in the Plating Shop and the premise that reducing the heat supplied to the tanks during the weekend hours will result in reduced steam usage. As the heated plating tanks are kept in such condition 8,760 hours per year, reducing the energy consumption of the tanks during the weekends will result in energy savings. The project will begin by identifying the tanks to be turned off and creating a shut down procedure for shop personnel to turn the tanks off on Friday afternoons and/or evenings.

Savings

Turning the tanks off during the weekend hours will result in energy savings in the form of decreased steam usage (Table 13).

Table 13. Plating tank heat loss.

Number	Tank	Tank Style*	Substance	Tank Temperature (°F)	Ambient Air Temperature (°F)	Heat Loss (Current) [Btu/hr]
1	55	13	Water	175	78	37,840
2	1A	11	Water	142	78	21,819
3	1B	11	Water	132	78	18,410
4	110	5	Water	164	78	6,804
5	44	12	Water	198	78	34,835
6	43	12	Dichromate sealer	168	78	26,127
7	131	5	Water	181	78	8,149
8	31	12	Cleaner	166	78	22,189
9	68	14	Chromate sealer	160	78	36,513
10	51A	17	Black oxide	88	78	322
11	51B	17	Black oxide	255	78	9,583
12	61	13	Phosphate	164	78	33,548
13	65	12	Phosphate	181	78	31,655
14	101	5	Chrome	130	78	4,114
15	102	5	Chrome	130	78	3,491
16	28	12	Water	129	78	13,263
17	11	12	Electro cleaner	158	78	17,965
18	165	3	Water	181	78	4,444
Totals						331,068
***** As specified in the RIA as-built drawings on file at Public Works.						

Using the resulting 331,068 Btu/hr and the annual energy savings are calculated as follows:

$$(331{,}068\ \text{Btu/hr}) \times (54\ \text{hr/weekend}) \times (52\ \text{weekends/yr}) = 930\ \text{MBtu/yr}$$

Note that if this recommendation is adopted along with the recommendation to insulate the plating tanks, the savings realized will be less due to the decreased heat loss engendered by the insulation.

The simple payback of this project is calculated to be nearly immediate, based on the costs of creating the necessary procedures as compared to the energy savings that is expected to result.

Investment

Table 14 lists investment cost estimates by item.

In practice, PL#5 requires very little investment except for the labor implicit in planning and scheduling. Existing software and planning tools can be used.

Payback

The payback is $2510/$5,222/yr = 0.5 years or 6 months based on the costs of creating the necessary procedures as compared to the energy savings that is expected to result.

Table 14. Investment cost estimates.

Item	Unit	Quantity	Unit Cost	Total Cost	Notes
Plating shop tanks (18 Total)	18				
Create shutdown procedure	EA	1	60	$1,080	1 hour per tank
Train employees on shutdown procedure	EA	1	60	$1,080	0.5 hour per tank per employee
Estimated contract cost				$2,160	
Contingency percent (10%)				$216	
Subtotal				$2,376	
Supervision, inspection & overhead (5.7%)				$135	
Total request				$2,511	
Total request (rounded)				$2,510	
Installed equipment-other appropriations				$0	

LCCA results Summary

First year savings	$5,222
Simple payback period (in years)	0.48 years
Total discounted operational savings	$78,067
Savings to Investment Ratio (SIR)	31.09
Adjusted Internal Rate of Return (AIRR)	22.31%

PL#6: Retrofit MAUs To Use High Efficiency/Low Static Pressure Drop Filters

Existing Conditions

The plating shop requires 13 air exchanges per hour during normal operating conditions. Through 16 Makeup Air Units (MAUs), approximately 513,000 cu ft per minute (cfm) of outdoor air passing thru for the ventilation needs of the shop. The MAU equipment in place is nearly 20 years old. The air is first passed through an air filter bank consisting of low-efficiency panel-type air filters in a serpentine arrangement. This filter geometry is relatively difficult to maintain, and offers limited options on the type of air filtration that can be used in the system. The air is heated to a requisite set point temperature (no cooling is available) by passing the air through a steam fed coil. Then the air is introduced into the shop area by a centrifugal fan and associated ductwork.

Each MAU has the following specifications:
- 33,200 cfm against 1 in. of external static pressure (except one at 13,000 cfm)
- 25 horsepower (nominal) motor operating at 1,750 rpm
- 3,400 MBH steam coil yielding a maximum 95 °F temperature increase.

The existing equipment is aged, dirty and clearly using more energy than required. By retrofitting the air handlers, improving the air filters, energy and labor savings are available. Because of the nature of the existing air filters, dirt has built up on the interior of the MAUs, the steam coil fins and the fan blades degrading the overall systemic efficiency of the MAUs. The required power to move the air is suboptimal.

Solution

The goal of this recommendation is to reduce the energy required in supplying the makeup air to the Plating Shop by improving the air filter section of the MAU allowing use of air filters with high efficiency/low static pressure characteristics, which will result in the following benefits:
- reduced energy consumption of MAUs
- improved air filter efficiency and dust holding capacity
- reduced air filter changes per year
- improved air quality to the plating shop.

This work consists of modifying the air filter racks in the 16 makeup air units (MAUs) serving the Plating Shop, cleaning (high pressure wash) the interior of the MAUs, including the steam heating coil and fan wheels and balancing the fan speed to original specified volumetric flow. Completing this work will realize energy and labor savings and improve indoor air quality. In addition, the MAUs will be cleaned and the fans balanced to specified air flows.

This work consists of modifying the air filter racks in the 16 makeup air units (MAUs) serving the Plating Shop, cleaning (high pressure wash) the interior of the MAUs, including the steam heating coil and fan wheels and balancing the fan speed to original specified volumetric flow. Completing this work will realize energy and labor savings and improve indoor air quality. In addition, the MAUs will be cleaned and the fans balanced to specified air flows.

The work will begin by dismantling the old serpentine-style air filter racks in the MAUs. Then the MAU will be cleaned with a high pressure washer (or equivalent), including the fan wheel and steam coil. This will maximize heat transfer in the steam coil and optimize airflow through the fan wheel.

Following the thorough cleaning of the MAUs, each air filter rack will be replaced with a face mounted rack system upstream of the air filter access door. The face mounted rack will use two sizes of racking only: 24-in. x 24-in. full-size air filter rack and 24-in. by 12-in., half-size air filter rack. (It is estimated that 15 24-in. x 24 in. racks are required per MAU.) The face mounted rack will be designed in such a way as to maximize the air filter area using the two sizes of air filter racks only with the remainder of the cross-sectional area being “blanked off” by sheet metal. By using standard rack sizes, air filters will be readily accessible to maintenance staff from vendors (i.e., no special-sized air filter orders will be required).

Following the reconstruction of the air filter racks, high efficiency/low static pressure air filters should be installed. It is suggested to use an air filter such as the Villedon® Pocket Filter Type F 45A or equivalent based on airflow specifications and initial static pressure at rated airflow. Care should be taken to ensure zero air bypass between the air filters and the racks exists, otherwise contamination of the coils and fan wheel can occur.

Finally, each MAU will be balanced to the original specification of 33,200 cfm/MAU (except one at 13,000 cfm). This can be accomplished my manipulating a variable-pitch sheave during a formal system balancing. Fan belts should be replaced as part of this balancing effort.

Impact if Not Provided

If this project is not completed, energy efficiency gains in the ventilation system cannot be realized. Performance of systems will continue to degrade due to increase contamination of the housing, fan blades, steam coils, and duct work likely resulting in further increases in electric energy consumption for each MAU.

Savings

This work is based on a comprehensive engineering study of the MAUs in the Plating Shop and the physical premise that (all things being equal) reducing static pressure in a ventilation system leads to a reduction in required power. Since these fans are operational 8,760 hours per year, even small horsepower savings will yield significant reductions in kilowatt hours consumed. The proposed modifications will last for the remaining life of the MAUs.

Additional savings can be achieved by prolonged filter change intervals, thus reducing both filter costs and labor for maintenance staff. Additional benefits are: IAQ improvement and better heat transfer on steam coils. Detailed savings calculations are shown below:

The brake horsepower required to move a given volume of air through a given static pressure is given by the following equation:

BHP = CFM * SP/(6356 * Ef)

Where:

CFM	=	total airflow in cu ft/ min
SP	=	static pressure (inches of water gauge)
6356	=	units constant
Ef	=	fan static efficiency.

The savings of electricity can be attributed to the reduction in required motor current. With all variables being equal except the static pressure relationship due to the new air filters, the total energy savings is given by the following equation:

ES = 0.746* [K * (SPold-SPnew)/(Em)]*h

Where:

K	=	constant
SPold	=	Initial static pressure drop of existing air filters (inches of water gauge)
SPnew	=	Initial static pressure drop of proposed air filters (inches of water gauge)
Em	=	Motor efficiency (estimated)
h	=	total number of motor operating hours (8,760)

Therefore, for all the MAUs, the energy savings are:

ES = 0.746* [121 * (0.4-0.12)/(0.85)]*8,760 = 260,500 kWh/year

Since operation is continuous, credit for demand savings can also be taken:

Summer Demand Savings = 29.7 kW x $9.14/kW x 4months/yr = $1,086/yr

Winter Demand Savings = 29.7 kW x $4.98/kW x 8months/yr = $1,183/yr

Total Demand Savings = $2,269/yr

Investments

Table 15 lists the investment cost estimates for all MAUs.

Table 15. Investment cost estimates.

Item	Unit	Quantity	Unit Cost	Total Cost	Notes
Plating shop MAUs (16 Total)	16				
Dismantle existing filter rack	EA	1	480	$7,680	2-MDs
Clean MAU, fan, and coil	EA	1	960	$15,360	4-MDs
Upgrade filter rack	EA	1	480	$7,680	4-MDs
Balance MAU to original spec	EA	1	720	$11,520	sub to T&B, 2-MDs
Full size air filters racks	EA	16	50	$12,800	$35 each
Full size air filters	EA	16	110	$28,160	$100 each
Existing air filter savings	EA	64	10	($10,240)	Four complete changes per year
Estimated contract cost				$72,960	
Contingency percent (10%)				$7,296	
Subtotal				$80,256	
Supervision, inspection & overhead (5.7%)				$4,575	
Total request				$84,831	
Total request (rounded)				$85,000	
Installed equipment-other appropriations				$0	

<u>Payback</u>

It is estimated the simple payback of this recommendation is 10.4 years based on air filter and energy cost savings alone.

LCCA results Summary

First year savings	$8,159
Simple payback period (in years)	10.40
Total discounted operational savings	$123,133
Savings to Investment Ratio (SIR)	1.45
Adjusted Internal Rate of Return (AIRR)	4.94%

Painting Areas

Painting Operation in Buildings 208

The spray paint area located in the Building 208 is capable of applying CARC (chemical agent resistant coatings). Other painting capabilities include production painting, camouflage and powder paint. There are three paint booths (8 ft, 45 ft, and 50 ft by 20 ft wide), two conveyor lines (large parts up to 1000 lb/300 ft long; small parts up to 500 ft long) and a drying booth (50 ft by 16 ft wide). Figure 9 shows the drive-through open top paint booth #1 in Building 208.

Figure 9. Open spray paint booth #1 in B-208 paint area.

Recommendation for Painting Operation in Bldg. 208

PN#1: Enclose Drive-Thru Paint Booth #1 in Bldg. 208

Existing Conditions

Much of the painting at RIA takes place in Building 208. The major painting booths are in an enclosed room on the north side of the building. Here the Drive-Thru booth #1 (close up view in Fig. 10) and a conveyor assisted booth/oven unit (booths #2 and #3) are located. On the west side of Building 208 there is a smaller conveyor assisted paint system for small parts. The drive-thru booth is used to paint the largest parts at RIA. Here long trailers that will not fit other booths and parts too heavy for the conveyor are painted. These parts are either wheeled into the booth or lifted in by the overhead crane. Some items like maintenance trailers are taller than a person and require the painter to climb on top of the equipment to paint the top side. This requires a protective harness to be attached to the painter as a safety measure against falls. After an item is painted it must be allowed to dry to touch before it can be moved.

Paint is applied with a compressed air paint gun. Generally an epoxy prime coat is first applied, followed by a top coat of a polyurethane chemical agent resistant coating (CARC) paint. After painting the solvents in the paint need to escape from the paint solution. This is called flash-off and takes 20 to 30 minutes. The paint then enters the drying mode. At room temperature of 70 °F the primer coat will dry to touch in 15 to 45 minutes and the top coat will dry to touch in 15 minutes. The appropriate paint thickness is 1.0 to 1.5 mils thickness for the primer and 1.8 mils for the top coat. A proper paint job should have a smooth, continuous, adherent paint film free of runs, sags, blisters, orange peel, streaks, craters, blotches fisheyes and pinholes.

Adjacent to the drive-thru booth #1 is a conveyor assisted paint booth/oven unit (#2 & #3). Hooks on the conveyor carry parts requiring painting into the paint booth. The conveyor is stopped to allow time to paint these parts then the conveyor is moved a distance of 10 to 20 ft. This takes the painted parts into the adjacent oven and brings a new batch of items to be painted.

Both painting systems are housed in a room approximately 350 ft long and 60 ft wide. There are two air supply units each rated at 115,000 CFM each for summer time airflow and 57,500 CFM for the winter time. The exhaust air volumes of 80,000 CFM (Booth #1) and 81,000 CFM (Booth # 2) flow continuously.

The size of booth #1 is 19 ft 8 in. by 39 ft. The top is open to the room and air is drawn through a 13-ft opening down to the exhaust openings located in the floor at each side of the booth. Four 25 horsepower motors power the exhaust fans that discharge the painting fumes outdoors. There are no doors to enclose the booth ends. Lights are found in the upper area of the side walls to provide illumination (Figure 10).

The heating and ventilation equipment operates continuously even though painting is not occurring. Since there is a wide variety of parts to paint and the schedule arrival of those parts to the paint booth is unpredictable, approximately 30 percent of the time there is no painting taking place due to the lack of personnel to operate the painting operation or the lack of product to paint.

Solution

The airflow can be better directed into Paint Booths #1 & #2 by enclosing the ends of the booths using doors that can be opened to allow moving of items to be painted. The exhaust air flow could then be reduced and still maintain proper capture of the paint overspray. The avoidance of cross drafts through the open ends will allow a reduction in the exhaust air flow by approximately 10 percent. It is proposed to install variable speed drives (VFD) on the fan motors. This would enable the system to operate at the current exhaust rate when paint objects that are too long to close the doors.

Figure 10. Close up view of Open Spray Paint Booth # 1 in B-208.

The VFD on the fan motors could also be controlled to reduce exhaust air flow when painting has ceased. An air flow switch in the compressed air line to the painting gun would monitor painting activity and after a 20 minute (adjustable) period from painting completion the air flow could be reduced to approximately 30 percent of the current rate.

To accomplish these savings movable doors would be installed at both ends of Booth #1 and the booth's top would be slightly enclosed. The enclosures on the top would also be moveable to allow crane clearance and to provide access when painting the top of trailers. When the doors and top enclosure are closed a limit switch will be tripped. This signal would be sent to the VFD controller allowing the fan to be run at a slower speed. An air switch would be placed in the compressed air line serving the paint guns. When no significant flow is sensed a signal will be sent to the VFD controller and after 20 minutes the fan will be slowed to operate at a minimum ventilation rate.

The same type approach can be applied to Booth # 2. The doors on the oven need to be made operable by installing an air cylinder to open and close them. This will enable the operator to easily operate the doors. At the entrance of the booth there also needs to be a new operable door installed. The addition of the door operators and the entrance doors will allow the side draft exhaust to better capture paint fumes and overspray. As the result the air flow can be reduced while maintaining the existing capture effectiveness. A minimum 10 percent reduction in air flow should be possible. In addition an air switch in the compressed air line will allow the air flow to be reduced by 70 percent when no painting activity is occurring.

Savings

The reduced air flow provides a lower electrical use of the exhaust system fan motors and a reduced winter time heating cost of bringing higher amounts of outside air into the building. The electrical savings are estimated to be 191,964 kWh/yr and the there would also be a reduced steam use of 2,972 MBtu a year.

Savings Calculations

Booth #1 has four 25 hp fan motors estimated electrical draw at 13.2 kW each.

It is estimated both booths will operate 30 percent of the time at low exhaust flow (30 percent of full flow) when no painting due to the lack of personnel to operate the painting operation of the lack of product to paint. Booth #2 will operate the remaining time at 90 percent of full flow due to less cross drafts in the booth. Booth #1 will operate at 90 percent of full flow for 60 percent of the time and for 10 percent of the time it will operate at full flow.

Current electrical use Booth #1 = 4 x 13.2 kW X 8760 hrs/yr = 462,528 kWh/yr

Using Reliance Electric energy program for VFD Booth #1 energy use = 270,564 kWh/yr

Booth #1 electrical energy savings = 462,528 – 270,564 = 191,964 kWh/yr

Heating Energy Savings

The difference between 72 °F inside and 36.6 °F average winter temp = 35.4 °F heating rise

Booth #1 Reduced Exhaust Air Flow, CFM

Not painting 30% X 80,000 CFM = 24,000 CFM

Painting 90% X 80,000 CFM = 72,000 CFM

Winter time = 5 months X 30 days/ month X 24 hrs/ day = 3,600 hrs/ yr

Not painting = 30% of the time = 1080 hrs/ yr

Painting @ 90% air flow = 60% of time = 2160 hrs/yr Booth #1

Booth #1 savings =1.08 X 35.4 °F (56,000 CFM X 1080 hrs + 8000 CFM X 2160 hrs) = 2,972 MBtu/yr

Investment

Table 16 itemizes the cost to enclose the ends of Paint Booths No. 1 & 2 using doors that can be opened.

Table 16. Cost to enclose the ends of Paint Booths No. 1 & 2 using doors that can be opened.

Item	Unit	Quantity	Unit Cost	Total Cost
Add bifold doors at each end and two sliding panels for the booth top	EA	1	$30,900	$30,900
Controls sliding panels	EA	1	$6,000	$6,000
25 hp motor VFD	EA	4	$5,675	$22,700
Controls for VFD	EA	1	$6,000	$6,000
Prepare space for installation	EA		$3,000	$3,000
Estimated contract cost				$68,600
Contingency percent (10%)				$6,860
Subtotal				$75,460
Supervision, inspection & overhead (5.7%)				$4,300
Total request				$79,760
Total request (rounded)				$79,800
Installed equipment-other appropriations				$0

Payback

Simple Payback for Booth #1 = $79,760/$21,034/yr = 3.79 years

LCCA results Summary

First year savings	$21,034
Simple payback period (in years)	3.79
Total discounted operational savings	$315,067
Savings to Investment Ratio (SIR)	3.95
Adjusted Internal Rate of Return (AIRR)	10.32%

PN#2: Enclose Paint Booth #2 in Bldg. 208

Existing Conditions

Adjacent to the drive-thru booth #1 is a conveyor assisted paint booth/oven unit (#2 and #3). Hooks on the conveyor carry parts requiring painting into the paint booth. The conveyor is stopped to allow time to paint these parts then the conveyor is moved a distance of 10 to 20 ft. This takes the painted parts into the adjacent oven and brings a new batch of items to be painted.

Booth # 2 (Figure 11) has an approximately size 20 ft wide by 40 ft long and its roof is partially closed. There are doors between the booth exit and the oven, but they normally left open by the operators. Exhaust air is removed from this booth by openings in both side walls. Four fans powered by 40 horsepower motors remove this exhaust and discharge it outside. Approximately 81,000 CFM of air is removed.

Figure 11. Paint Booth # 2 in B-208.

Booth No. 1 and Booth No. 2 are housed in a room approximately 350 ft long and 60 ft wide. There are two supply units each rated at 115,000 CFM each for summer time airflow and 57,500 CFM for the winter time. This heating and ventilation equipment as well as the booth exhaust operates continuously even though painting is not occurring. Since there is a wide variety of parts to paint and the schedule arrival of those parts to the paint booth is unpredictable, approximately 30 percent of the time there is no painting taking place due to the lack of personnel to operate the painting operation or the lack of product to paint.

Solution

The airflow can be better directed into Paint Booth #2 by enclosing the ends of the booths using doors that can be opened to allow moving of items to be painted. The exhaust air flow could then be reduced and still maintain proper capture of the paint overspray. The avoidance of cross drafts though the open ends will allow a reduction in the exhaust air flow by approximately 10 percent. It is proposed to install variable speed drives (VFD) on the fan motors. This would enable the system to operate at the current exhaust rate when paint objects that are too long to close the doors. The VFD on the fan motors could also be controlled to reduce exhaust air flow when painting has ceased. An air flow switch in the compressed air line to the painting gun would monitor painting activity and after a 20 minute (adjustable) period from painting completion the air flow could be reduced to approximately 30 percent of the current rate.

To accomplish these savings movable doors would be installed at entrance of Booth No. 2 and the doors on the oven side would need to be made operable by installing a device to open and close. This will enable the operator to easily operate the doors. Doors currently exist at the entrance and exit of the oven, but they must be moved by hand and thus are always left open.

When the doors to the booth are closed a limit switch will be tripped. This signal would be sent to the VFD controller allowing the exhaust fans to be run at a slower speed. An air switch would be placed in the compressed air line serving the paint guns. When no significant compressed air flow is sensed a signal will be sent to the VFD controller and after 20 minutes the fan will be slowed to operate at a minimum ventilation rate.

The addition of the door operators and the entrance doors will allow the side draft exhaust to better capture paint fumes and overspray. As the result the air flow can be reduced while maintaining the existing capture effectiveness. A minimum 10 percent reduction in air flow should be possible. When no painting activity is occurring , the exhaust air flow can be reduced by 70 percent.

Savings

The reduced air flow provides a lower electrical use of the exhaust system fan motors and a reduced winter time heating cost of bringing higher amounts of outside air into the building. The electrical savings are estimated to be 235,924 kWh per year and the there would also be a reduced steam use of 3,122 MBtu a year.

Savings Calculations

Booth #2 has four 40 hp fan motors estimated electrical draw at 14.7 kW each. It is estimated the booth will operate 30 percent of the time at the low exhaust flow (30 percent of full flow) when there is no painting due to the lack of personnel to operate the painting operation of the lack of product to paint. Booth No. 2 will operate the remaining time at 90 percent of full flow due to less cross drafts in the booth due to the doors being closed

Current electrical use Booth #2 = 4 x 14.7 kW x 8760 hrs/yr = 515,088 kWh/yr

Using Reliance Electric energy program for VFD Booth #2 energy use = 4Fans x 14.7 kW/Fan x 8760Hr x ((.3 x .3) + (.7 x .9)) = 370,863 kWh

The electrical energy savings = 515,088 – 370,863 = 144,225 kWh/yr

Heating Energy Savings

The difference between 72 °F inside and 36.6 °F average winter temp = 35.4 °F heating rise

Booth #2 Reduced exhaust air flow, CFM

Not painting 30% x 81,000 CFM = 24,300 CFM

Painting 90% x 81,000 CFM = 72,900 CFM

Winter time = 5 months x 30 days/ month x 24 hrs/ day = 3,600 hrs/ yr

Not painting = 30% of the time = 1080 hrs/ yr

Painting @ 90% air flow = 70% of time = 2520 hrs/yr for Booth #2

Booth #2 savings = 1.08 x 35.4 °F (56,700 CFM x 1080 hrs + 8100 CFM x 2520 hrs) = 3,122 MBtu/yr

Since operations are continuous and there will always be at least a 10 percent reduction in demand, savings can also be taken credit for demand reduction:

Demand Savings = 4Fans x 14.7kW/Fan x .1 = 6 kW

Winter savings = 6 kW x $4.98/kW x 8 months = $239/yr

Summer savings = 6 kW x $9.14/kW x 4 months = $219/yr

Total demand savings = $458/yr

Investment

Booth #2 – Add doors and VFDs on fan motors

Table 17 itemizes the cost to enclose the ends of Paint Booth #2 using doors that can be opened.

Table 17. Cost to enclose the ends of Paint Booth #2 using doors that can be opened.

Item	Unit	Quantity	Unit Cost	Total Cost
Add three sets of new doors	EA	3	$20,300	$60,900
Add controls	EA	1	$8,000	$8,000
40 hp motor VFD	EA	4	$9,000	$36,000
Controls for VFD	EA	1	$6,000	$6,000
Prepare space for installation	EA		$3,000	$3,000
Estimated contract cost				$113,900
Contingency percent (10%)				$11,390
Subtotal				$125,290
Supervision, inspection & overhead (5.7%)				$7,140
Total request				$132,430
Total request (rounded)				$132,400
Installed equipment-other appropriations				$0

Payback

Simple Payback = $132,430/$21,253/yr = 6.23 years

LCCA results Summary

First year savings	$21,253
Simple payback period (in years)	6.23
Total discounted operational savings	$318,259
Savings to Investment Ratio (SIR)	2.40
Adjusted Internal Rate of Return (AIRR)	7.62%

Painting Operation in Building 299

In Building 299 there are two painting systems. The first is a conveyor-assisted unit (#4) that is used to paint various parts. This system is set up to have a conveyor run continuously with the painted parts being dried in the adjacent oven and then the parts are removed and unpainted parts loaded on the conveyor. The second painting system is a large combination paint booth and oven unit (#5) that can handle drive-in vehicles. Like the painting operations in Building 208, these operations are quite busy with production scheduled 24 hours per day, 7 days/week. There are 15 people assigned to these systems; five for each of the three shifts.

PN#3: System Improvements for Paint Booth #4 in Building 299

Existing Condition

Both of the painting systems #4 (Figure 12) and #5 in Building 299 have an air supply unit that delivers heated air into the booths and oven. There are fans that exhaust air that is not wanted. Painting system #4 has a heating and ventilating units for both the paint spray booth as well as the oven. Most of the air in the oven is recirculated where the spray booth's 32,000 CFM supply air is totally exhausted. A variable speed conveyor moves the parts through the painting operation. For the combination booth/oven the supplied air is totally exhausted with two fans removing 38,000 CFM. A steam heating and ventilating unit maintains oven temperatures up to 130 °F. as well as supplying ventilation air during painting operations.

Figure 12. Paint Booth/Oven #4 in B-299.

The conveyor assisted paint booth and oven #4 has openings through which the conveyor travels. The air flow between the booth and oven are in need of balancing. Currently heated air from the oven is drawn to the booth by the suction of the exhaust system. This situation can be corrected by balancing the air flow in the paint booth. The combination paint booth/oven #5 has doors at each end, both of which are closed before painting begins.

The heating and ventilation equipment operates continuously even though painting is not occurring. Since there is a wide variety of parts to paint and the schedule arrival of those parts to the paint booth is unpredictable, approximately 30 percent of the time there is no painting taking place due to the lack of personnel to operate the painting operation or the lack of product to paint.

The conveyor assisted paint booth and oven #4 at times has difficulty in drying some of the urethane paints in one cycle through the oven. These parts must be kept on the conveyor and allowed to pass again through the oven. It is estimated that 20 percent of the time the painting system is in this mode, which idles the three men assigned to this system

Solution

The conveyor assisted booth and oven will have its oven size doubled by extending its length by 25 ft. This will double the residence time in the oven and all painted parts will be able to dry properly in a single pass. Parts can receive the prime coat, be dried in the oven, then be painted with the top coat and again dried in the oven At the oven outlet they can be unloaded and unpainted parts be placed on the conveyor. Loss production time waiting for part drying will be avoided. This will improve the productivity of this painting system. The result is a 20 percent saving of labor costs and spray booth operating costs.

To adjust the ventilation fans so that they operate at reduced flow when there is no painting a VFD will be installed on the fan motors. The fans will operate at 30 percent of normal flow during these periods. This will also reduce the need to temper this extra air during the winter.

Savings

The reduced air flow provides a lower electrical use of the exhaust system fan motors and a reduced winter time heating cost of bringing higher amounts of outside air into the building. The electrical savings are estimated to be 179,489 kWh per year and the there would also be a reduced steam use of 5,670 MBtu a year.

Reduced Air Flow When Not Painting

Booth #4 has three 15 hp fan motors plus four 1 – 3 hp motors, total estimated electrical draw at 43.2 kW each.

It is estimated both booths will operate 30 percent of the time at low exhaust flow (30 percent of full flow) when no painting occurs.

Current electrical use Booth #4 = 43.2 kW x 8760 hrs/yr = 378,432 kWh/yr

Using Reliance Electric energy program for VFD Booth #4 energy use = 43.2 kW x 8760Hrs/yr x ((.3 x .3) + (.7 x 1)) = 298,961 kWh

Electrical energy savings = 79,471 kWh/yr

Heating Energy Savings

The difference between 72 °F inside and 36.6 °F average winter temp = 35.4 °F heating rise

Reduced Exhaust Air Flow, CFM

Booth #4 Not painting =30% x 36,000 CFM = 10,800 CFM

Oven #4 Not painting = 30% x 38,000 CFM = 11,400 CFM

Winter time = 5 months x 30 days/ month x 24 hrs/ day = 3,600 hrs/ yr

Not painting = 30 % of the time = 1080 hrs/ yr

Booth #4 savings = 1.08 x 35.4 °F (10,800 CFM x 3,600 hrs/yr) = 1,486 MBtu/yr

Oven #4 savings = 1.08 x (130 °F–36.6 °F) x 11,400 CFM x 3,600 hrs/yr= 4,193 MBtu/yr

Total savings = 5,679 MBtu/yr

Larger Oven #4

Electrical energy savings = 378,432 kWh/yr x 0.2 = 75,686 kWh/yr

Heating energy savings

Booth #4 savings = 1.08 x 35.4oF x 36,000 CFM x 3,600 hrs/yr x .2 = 991 million Btu/yr

Oven #4 savings = 1.08 X 130oF-36.6oF) x 38,000 CFM x 8,760 hrs/yr x .2 = 6,716 MBtu/yr

Total heating savings = 7,707 MBtu/yr

Total Employee Labor Savings = 3 people x $60,000/yr x .2 = $36,000

Investment

Booth #4 – Enlarge Oven and add VFD on Fan Motors

Table 18 itemizes the cost to enlarge the oven and add VFD on fan motors in Booth #4.

Table 18. Cost to enlarge oven and add VFD on fan motors in Booth #4.

Item	Unit	Quantity	Unit Cost	Total Cost
Enlarge oven, extend conveyor & modify ducts	EA	1	$100,000	$100,000
15 Hp motor VFD	EA	3	$3,550	$10,650
5 Hp motor VFD	EA	2	$2,400	$4,800
VFD controls	EA	1	10,000	$10,000
Estimated contract cost				$125,450
Contingency percent (10%)				$12,545
Subtotal				$137,995
Supervision, inspection & overhead (5.7%)				$7,865
Total request				$145,860
Total request (rounded)				$146,000
Installed equipment-other appropriations				$0

Payback

Simple Payback = $145,860/$114,675= 1.27 years

LCCA results Summary

First year savings	$114,675
Simple payback period (in years)	1.27 years
Total discounted operational savings	$1,720,247
Savings to Investment Ratio (SIR)	11.79
Adjusted Internal Rate of Return (AIRR)	16.53%

PN#4 System Improvements for Paint Booth #5 in Building 299

Existing Condition

Painting system #5 (Figure 13) in Building 299 is combination paint booth/oven and it has doors at each end which are closed before painting begins. The paint booth has a 38,000 CFM air supply unit that delivers heated air into the booth and two exhaust fans that remove this air. The temperature can be raised to 130 °F when the enclosure is performing the function of an oven. There are when the systems are operating.

The heating and ventilation equipment operates continuously even though painting is not occurring. Since there is a wide variety of parts to paint and the schedule arrival of those parts to the paint booth is unpredictable, approximately 30 percent of the time there is no painting taking place due to the lack of personnel to operate the painting operation or the lack of product to paint.

Figure 13. Paint Booth/Oven #5 in B-299.

The combination booth/oven needs to be able to re-circulate a percentage of the air delivered to the enclosure. This will provide energy savings which will reduce operating costs.

Solution

For the combination Booth/Oven #5, provide a duct that will allow exhaust air to be re-circulated back through the booth/oven while in the drying mode. This occurs an estimated 40 percent of the time. Dampers in a new cross connection duct that will be placed between the exhaust ducts and the air intake for the heating and ventilating unit. When the paint system is in the painting mode all the supply air will be exhausted as is currently the case. When the system is in the drying mode the crossover duct will allow 70 percent of the exhaust air to be directed to the supply unit air intake by opening and closing dampers.

To adjust the ventilation fans so that they operate at reduced flow when there is no painting a VFD will be installed on the fan motors. The fans will operate at 30 percent of normal flow during these periods of no painting. This will also reduce the need to temper this extra air during the winter.

Savings

The reduced air flow provides a lower electrical use of the exhaust system fan motors and a reduced winter time heating cost of bringing higher amounts of outside air into the building. The electrical savings are estimated to be 66,778 kWh per year and the there would also be a reduced steam use of 10,971 MBtu a year.

Reduced Air Flow When Not Painting

Booth #5 has one 50 hp and two 7.5 hp fan motors, total estimated electrical draw 36.3 kW

It is estimated both booths will operate 30 percent of the time at low exhaust flow (30 percent of full flow) when no painting occurs.

Current electrical use Booth #5 = 36.3 kW X 8760 hrs/yr = 317,988 kWh/yr

Using Reliance Electric energy program for VFD Booth #5 energy use = 36.3 kW x 8760Hr/yr x ((.3 x .3) + .7)) = 251,210 kWh/yr

Electrical energy savings = 66,778 kWh/yr

Heating Energy Savings

The difference between 72 °F inside and 36.6 °F average winter temp = 35.4 °F heating rise

Reduced exhaust air flow, CFM

Booth #5 Not painting = 30% x 38,000 CFM = 11,400 CFM

Winter time = 5 months x 30 days/ month x 24 hrs/ day = 3,600 hrs/ yr

Not painting = 30% of the time = 1080 hrs/ yr

Booth #5 savings = 1.08 x 35.4 °F (11,400 CFM x3600 hrs/yr) = 1,569 MBtu/yr

Total savings = 1,569 MBtu/yr

Re-Circulate Oven #5 Air

Electrical energy savings = $0

Heating Energy Savings

Oven operates 40% of 8760 hrs/yr = 3,504 hrs/yr

Oven #4 savings = 1.08 x (130 °F-36.6 °F) x 38,000 CFM x 3,504 hrs/yr x .7 = 9,402 MBtu/yr

Total heating energy savings = 1,569 + 9,402 = 10,971 MBtu/yr

Investment

Table 19 lists the cost to add ducts and dampers to recirculate air and add VFD on fan motors (Booth No. 5).

Table 19. Cost to add ducts and dampers to recirculate air and add VFD on fan motors (Booth No. 5).

Item	Unit	Quantity	Unit Cost	Total Cost
Provide ducts, dampers and controls for air recirculation	EA	1	$20,000	$20,000
50 hp motor Vfd	EA	1	$10,000	$10,000
7.5 hp motor Vfd	EA	2	$2,850	$5,700
Vfd controls	EA	1	$6,000	$6,000
Prepare space	EA	1	$1,000	$1,000
Estimated contract cost				$42,700
Contingency percent (10%)				$4,270
Subtotal				$46,970
Supervision, inspection & overhead (5.7%)				$2,680
Total request				$49,650
Total request (rounded)				$49,700
Installed equipment-other appropriations				$0

Payback

Simple Payback = $49,650/63,114= 0.79 years

LCCA results Summary

First year savings	$63,114
Simple payback period (in years)	0.79 years
Total discounted operational savings	$943,758
Savings to Investment Ratio (SIR)	19.01
Adjusted Internal Rate of Return (AIRR)	19.34%

Heat Treatment

Heat treating capabilities at RIA (Figure 14) include annealing, hardening, tempering, surface carburizing, carbon restoration, induction hardening, etc. Forty furnaces are available for use with envelope sized to 48 in. x 144 in. Load weight can be up to 60,000 lb and uniformity surveyed up to 2400 °F. There is 24-hour monitoring system for quality control.

Figure 14. Heat treating operation in Building 222.

Recommendations for Heat Treating Operation

HT#1: Install Thermocouples To Provide Uniformity Surveys for Furnaces in Bldg. 222

This Phase1 recommendation was reviewed by the Heat Treat management team during the Phase2 study and judged to be a lower priority issue. No further work will be done on HT#1.

HT#3: Install an Endothermic Generator

This Phase 1 recommendation was reviewed by the Heat Treat management team during the Phase 2 study and judged to be a lower priority issue. No further work will be done on HT#3.

HT#5: Heat Treat Ventilation Improvements (Smoke Control, Balance Airflow and Improve Local Exhaust)

Existing Condition

The heat treating operations at RIA take place in Building 222 (Figures 15, 16, 17 and 18). This is a high somewhat narrow building that takes advantage of natural ventilation during the non-heating seasons. Upper sash areas are opened and several exhaust fans operate to remove the hot air and smoke created by heat treating operations below. There are lower wall panel that open as well as doors to allow outside air to enter the building. Two heating and ventilating units located at an elevation approximately 35 ft from the floor (above the crane rails) also provide supply air. This outside air is distributed at this elevation which has little effect on personnel working at floor level due to the short circuiting to the building's exhaust without reaching floor level. As the result it is cold at the floor level during the winter. Trying to make the building warmer, Johnson Control staff is encouraged to increase supply air temperature set point of these heating and ventilating units. The result is an increase in energy use but a small impact on the actual temperature at floor level; it just gets hotter underneath the ceiling.

The current heating and ventilation units (HVUs 222-1-3 and 222-1-4) have a capacity of 32,500 CFM each. But in the winter they were designed to operate at half flow and thus have inadequate steam coils for full airflow. The air exchange rate provided by the units in the winter is approximately two air changes per hour and 1 cfm per sq. ft. of floor space. Heat treat facilities commonly have twice this ventilation rate. During the Phase 2 visit, these units were operating at 10 percent outside air with a leaving air temperature of 130 °F. This is an inadequate ventilation rate not even enough to over come the air leaving the building. Thus cold air is infiltrating into the workspace and making that area cold.

Figure 15. High level diffusers in Heat Treat.

Figure 16. Heat treat area showing exhaust systems

Figure 17. Heat treat furnaces.

Figure 18. Heat treat furnaces and quench tanks.

The ventilation rates are also inadequate to dilute/remove smoke from the workspace. Smoke is common in heat treat operations and is created by burning of oil coatings on parts as they enter hot furnaces and in some cases quenching hot parts in oil baths. Only a few furnaces are equipped with exhaust hoods to capture the oily smoke created.

Solution

The air distribution from the existing heating and ventilating units (HVU) can be improved by dropping ducts from the large main duct. The ducts will be brought to approximately the 12-ft level above the floor so the air can be directed into the level where the people work. At the end of each duct install a high velocity diffuser aiming 45 °F out from the wall and downwards. Most of the air will be brought down at the ends of the building to avoid interfering with the movements of the two overhead cranes. Close the dampers in all the existing branch ducts in the upper strata except the four centre ones. Replace the diffusers in those four ducts with new, high velocity diffusers, pointing directly to floor level.

This will make it a total of four diffusers at east wall and four at west wall plus four in the centre. The system should be balanced to provide 40 percent of total airflow, at full speed of HVUs, to each wall and 20 percent of the airflow in the centre of the building. This will make sure that the air supply really reaches the occupancy zone in heat treatment.

A supplemental heating and ventilating unit having a capacity of 35,000 CFM will be installed on the outside near the center of the building. This unit will operate when additional ventilation is required as dictated by the level of heat treat operations. The unit will supply all outside air which will be heated by direct-fired gas. The installed cost of this unit is less than a steam heating unit and has none of the freezing problems. It is proposed this unit operate only when needed and thus the higher operating cost of burning gas will be kept to a minimum.

The operation of HVUs 222-1-3 and 222-1-4 should be changed as that they always be run at full speed. During wintertime, the units should be run at minimum level of outdoor air (today set to 10 percent but could be changed if necessary) that is adequate to satisfy the air leaving the building. The outdoor air amount should be increased with respect to how many exhaust fans are operating (see pressure control below). The outdoor air can also be reduced when the cooling units on top of air compressors are bringing heated fresh air into the building. If the required outdoor air quantity exceeds the maximum heating capacity of the units (16,000 CFM per unit on a design day), then the supplemental gas fired unit should be started.

In summer the units should be run at full speed and with 100 percent outdoor air. Exhaust fans, EF-222-R3 – R12, should be operated manually but with timer function. When they are switched to the “ON” position, the exhaust fans are to run for a certain time, programmed in the timer, after which their operation stops.

A new operating control panel for manual operation of exhaust fans and for an emergency situation (air purging) with full exhaust and supply air flows should be installed. This control panel should also be able to provide building pressure control. This will require the installation of new pressure sensors capable of measuring the difference between outdoor and indoor air pressure. The signal from these sensors (representing the differential pressure) should control the HVUs so that they always work to keep the pressure difference at a minimum.

To better capture the oily smoke those operations that are the major source of this contaminant should be evaluated for new hoods. Local smoke removal equipment can be used to clean the exhaust air and thus avoid long runs of exhaust duct to take the smoke outside.

These improvements will remove significant amounts of the smoke and provide a better ventilation air flow. The ventilation modifications will get outside air into the lower portion of the plant and allow warm air from the heat treat processes to rise and be expelled through the roof. The warm air movement will carry away some of the smoke and other airborne contaminants. In the winter, warm supply air will be discharged at the worker level and the temperature of this space will be more comfortable. Cold drafts will be kept to a minimum by increasing the outdoor air brought into the building.

Savings

This project will achieve savings from improved air quality in the heat treat building. The space temperature will also be improved and the existing heating system will operate more effectively.

Energy related savings can be achieved from taking the following measures:

- Run HVUs 222-1-1 and 222-1-2 on 100 percent return air in winter. Air compressor air handling units (AHUs) should provide as much outdoor air supply into Building 222 as is possible with respect to how the air compressors are run. Savings in steam by these units and with proper operation amount to approximately $3,000/year (difficult to calculate but this is a fair estimate).
- During non-working hours, the HVUs 222-1-3 and 222-1-4 shall operate on 100 percent return air. The steam savings by not mixing with 10 percent outdoor air, 22,500 cfm/unit in winter mode, for 108 hours/week, is 200 MWh worth about $1,600/year.

Investment

For duct changes to the existing HVUs:	$30,000
Supplemental gas fired AHU	$70,000
Controls	$20,000
Hood engineering	$25,000
Total cost with overhead	$168,600

Table 20 itemizes the required investments.

Table 20. Investments required for heat treat ventilation improvements.

Item	Unit	Quantity	Unit Cost	Total Cost
Duct modifications to existing ventilation system	EA	1	$30,000	$30,000
35,000 cfm direct gas fired unit with air discharge	EA	1	$70,000	$70,000
Controls	EA	1	$20,000	$20,000
Hood engineering	EA	1	$25,000	$25,000
Estimated contract cost				$145,000

Item	Unit	Quantity	Unit Cost	Total Cost
Contingency percent (10%)				$14,500
Subtotal				$159,500
Supervision, inspection & overhead (5.7%)				$9,092
Total request				$168,592
Total request (rounded)				$168,600
Installed equipment-other appropriations				$0

Payback

On energy: $168,600/ $4,600/yr = 36.6 years (not a good energy saving project)

On IAQ and improved working conditions: Immediately

Machining Operations

Turning (lathe), milling, drilling, and tapping operations are performed in the oldest part of the World War I Wing within the center. The newest computer controlled metalworking equipment (4-axis and 7-axis machines) is located in the New Wing (Figures 19, 20, and 21).

Figure 19. Machining operations.

Figure 20. Machining in the machine shop.

Figure 21. Machine in the machine shop.

Recommendations for Machining Operation

MC#1: Install Radiant Heaters for Carefully Selected Machines and Associated Work Stations in Bldg. 220

Existing Condition

In the wintertime, the machine shop floor temperatures vary from 35 to 65 °F. This uncontrolled condition adversely impacts both the performance of the machinist and the machining precision. The existing heating system is incapable of heating the very high bay area (55 ft high x 40 ft x 400 ft) at the floor level. This combined with the inability to close the north wall windows results in a heating efficiency and effectiveness of only 10 to 20 percent. The consequence is: (1) low worker productivity, (2) product re-work due to wide variations in machine tolerances from temperature changes, and (3) low production capacity that extends turnaround time (TAT).

Solution

The need for this recommendation is being satisfied by implementing recommendation BE #1 which will close the windows on the north wall of this space eliminating the infiltration of outside air which causes this area to be cold. Additional air will be delivered to this space by reworking the heating and ventilating units in the area.

Savings

See BE #1

Investment

See BE #1

Payback

See BE #1

MC#2: Chrome Grinding Machine Exhaust Systems with Dust Filters

Existing Condition

Some of the parts used to repair the Army equipment are obtained by applying a chrome layer over the worn surface of a used part in the plating department. This chrome layer is then machined and ground to satisfy the specification of the part when it was new. At Rock Island Arsenal there are several grinding operations that work on reconditioned parts. Some of the grinding is accomplished with a cooling fluid sprayed over the grinding surface. Other parts are ground dry with no fluid being used.

No exhaust systems are applied to these grinding operations as shown in the following photographs. Grinding requires an exhaust system to protect those operating the machine from the abrasive particles that make up the grinding wheel as well as the metal particles taken off the part. Minimum exhaust air volumes based on the wheel diameter are identified in OSHA regulations.

Solution

On each grinding machine provide an enclosure or local capture hood with required duct system to an air cleaning device and fan. It is intended that this exhaust air would be returned to the space inside the building. Where appropriate an enclosure will be placed around the grinding operations. If there is no practical method to use an enclosure, a close capture hood will be used.

Savings

This recommendation is for the health and safety of the workers and no saving will result from the installation.

Investment

To identify the most appropriate exhaust hood for the grinding operations a detailed engineering evaluation is required. These hoods will need to be effective in capturing the airborne particles generated by the grinding activity. These hoods must be placed in a location that does not interfere with the machine operator seeing what is needed to deliver quality parts. He also must be able to dress the grinding wheel, change parts and set the machine up to perform its task. The cost for evaluating three different grinders is $30,000. Included in this cost is the construction of prototype hoods and testing of their operation. A fan and filter system will be required to test hood performance. The total cost of providing hoods for all grinders will be determined as part of the hood design engineering activity identified above.

Foundry

The foundry uses a variety of furnaces (e.g., electric induction,) to melt the various metals for casting/forging. The two direct arc electric furnaces are capable of handling up to 3 or 5 tons of material and of operating at temperatures of 3300 °F. Samples of the slugs from these furnaces are taken periodically to check on quality.

Non-ferrous metals are melted in the induction furnaces. About 22 lb of alloys can be processed in 18 minutes. These materials are used in investment casting. This is a precision casting method that results in machined-like quality at significantly lower costs. The molds for the parts are made of Furan. Forging is accomplished with the use of hydraulic presses, which can exert up to 1,000 tons of pressure. Additionally 16,000 psi hammers are used.

Recommendations for Foundry Operation

FD#1: Replace Critical Foundry Equipment in Bldg. 212 West

Existing Condition

Most of the existing foundry equipment is: (1) high maintenance, (2) unreliable with excessive downtime, (3) high energy and materials cost, and (4) a production bottleneck.

Solution

Replace old, unreliable, inefficient foundry equipment that is critical to shop performance.

Savings

- reduced down time
- reduced maintenance costs
- reduced turn-around-time
- reduced energy costs
- higher labor efficiency
- reduced materials cost.

The data in Table 21 summarize the assumptions and cost basis of savings that form the basis for economic (savings) calculations.

Table 21. Basis for economic calculations: assumptions and cost basis of savings.

Foundry Shop Annual Budget	100%Budget (k$/yr)	Potential Savings Factors	
		10% (k$/yr)	1% (k$/yr)
Labor Cost (12 x $60K/yr)	$720	$72.0	$7.2
Materials cost ($600K/yr + $200k/yr)	$800	$80.0	$8.0
Utilities cost (electric $200K/yr+CA $50K/yr)	$250	$25.0	$2.5
Electricity ($0.041/kWh) Comp air ($0.135/kcf) Air conditioning ($41/k-ton hrs)			
NG ($7.00/MBtu)			
Steam ($5.00/MBtu)			
Water ($3.50/kgal); Boiler Feed Water ($5.00/kgal) Hazardous waste water ($500/kgal)			
Other (including Environmental)	$1,000	$100.0	$10.0
Total Shop Budget	***$2,770***	***TAT=$192.0****	***TAT $19.2***

TAT= ($2,770 x 10%) – $80 – ($25X20%) = $192K/year

Process operating performance data, potential savings and cost estimates/assumptions. This is based on a combination of actual data and "educated guesses" made jointly by the PEOA Foundry Team (Tables 22 and 23).

- There are 12 employees (direct and indirect) @ $60K/yr.
- Costs for materials, utilities, environmental and other were estimated by the Foundry Team.

Table 22. Savings calculation.

Savings Categories	Calculation	Cost savings (k$/yr)
1. Labor savings	$720K/yr total x 10% savings (less rework)	$72.0
2. Materials savings	$800K/yr total x 5% savings	$40.0
3. Energy savings	$250K/yr total x 10% savings	$25.0
4. Maint materials, labor savings	$250K/yr total manta., materials, labor x 10% savings	$25.0
5. TAT savings	$192K/yr per 10% x 10% savings	$192.0
6. Total savings with TAT	(1 + 2 + 3 + 4 + 5)	$354.0
7. Total savings without TAT	(6) – (5)	$162.0

Investment

Table 23. Investment cost estimate.

Item	Unit	Quantity	Unit Cost	Total Cost
Purchase and install manipulator to lift casting	EA	1	$225,000	$225,000
Purchase and install blast unit – twin table, twin head	EA	1	$125,000	$125,000
Purchase and install shell core machine	EA	1	$125,000	$125,000
Purchase and install two (2) new mixers	EA	2	$62,500	$125,000
Demolition of existing equipment	EA	1	$40,000	$40,000
Estimated contract cost				$640,000
Contingency percent (10%)				$64,000
Subtotal				$704,000
Supervision, inspection & overhead (5.7%)				$40,128
Total request				$744,128
Total request (rounded)				$744,100
Installed equipment-other appropriations				$0

Payback

Simple payback with TAT = $744.1K / ($354K/year) = 2.1 years

Simple payback without TAT = $744.1K / ($162K/year) = 4.6 years

The data in Table 24 summarize economic benefits.

Table 24. Economic and benefit summary.

Net Savings, Cost and Payback	Amount
Improved TAT savings (K$/yr)	$192.0
Materials cost savings (K$/year)	$40.0
Labor savings (K$/yr)	$72.0
Maintenance savings – MM&L (K$/yr)	$24.0
Energy savings (K$/yr)	$25.0
Environmental savings (K$/yr)from	N/A
Total savings with TAT (K$/yr)	$354.0
Total savings without TAT (K$/yr)	$162.0
Installed cost (K$)	$744.1
Simple payback with TAT (years)	2.1
Simple payback without TAT (years)	4.6

FD#2: Improve Ventilation in the Foundry

Existing Conditions

All ventilation units in the foundry in Building 212 are operated manually. There are four AHUs, each at 50,000 cfm. The foundry suffers from large negative pressures, leading to slamming doors on occasions, with hazardous conditions for people passing through the doors. Exhaust air fans, some of which connected to baghouses, are also switched on and off manually. During the CERL visit, the activities in the foundry were on a very low level.

Solution

Evaluate new foundry equipment that has been ordered for ventilation requirements. Incorporate recommendations from the Foundry Ventilation Study completed in December 2004 into a new ventilation system for the Foundry. Use building static pressure sensors to control VFDs installed the Foundry's supply air handling unit's fans. Connect these AHUs to the Johnson Controls' control center to allow for scheduling of operation time.

Savings

Significant savings can be obtained by improved control of the ventilation equipment. Specific amounts need to be determined through evaluation.

Investments

To be determined.

Payback

To be determined.

Welding Area

The fabrication of weapons systems components manufactured at RIA requires different welding processes, e.g., Gas Metal Arc Welding (MIG), Gas Tungsten Arc Welding (TIG), Submerged Arc, Inertia, Electron Beam, Stick Welding, Robotics Welding, Orbital Welding and Flexible Welding System. In the later process, all parts are tack welded in dedicated fixtures, preheated in ovens, placed into finish weld fixtures, and then finish-welded by semiautomatic or manual means. Upon completion, they are sent to the inspection department for visual and magnetic particle inspection of all welds. Major welding jobs are carried out in Building 212 welding area (Figure 22).

Figure 22. Welding Area.

Recommendation for Welding Operation

WD#1: Replace Extraction Arms in Welding Shop With a New Demand-Based Exhaust System

Existing Conditions

In the welding shop there are exhaust arms that are in poor condition and they are normally not being used. The arms do not have enough exhaust capacity and dampers are operated manually. The system runs at Constant Air Volume. The exhaust air is taken out via three SUN Air Handling Units with filters to clean the exhaust air. The cleaned exhaust air is delivered back to the welding shop in winter. The change between winter and summer modes is done manually from a panel in the welding shop area.

The following observations have been made regarding extraction arms and connected exhaust systems:

1. The three SUN AHUs today serve a total of 33 exhaust arms at welding booths. Some booths have two extraction arms. The arms are difficult to use, mainly because of their weight, there are hard to move. They are also severely clogged, which makes air flow through hoods very low. This occurs even with the manual dampers in fully open position.
2. We measured the total airflow in the ventilation ducts leading to the SUN AHUs. It varies a little between the three units but the total airflow was 8,500 cfm. The design data for the SUN units is that each unit should exhaust 10,000 cfm each. We are very far from this situation, receiving only 28 percent of the designed airflow. The main reason for this is that the fan motors are two small; they cannot deal with the pressure drop in the hoods, arms, ducts, and filters.
3. The SUN AHUs are otherwise in a good condition. The fan size is sufficient for the designed airflow. The filters are good and are suggested to be kept in the units. The filters remove the dust from welding in accordance with specifications. The cleaning of the filters, with compressed air, works as it should.

Solution

Take away all existing arms and booms. Keep ventilation ducts (exhaust). Replace exhaust arms and booms with new ones, equipped with automatic dampers, which open rapidly as a sensor detects that welding is started (Figure 23). The sensor clamp is fitted to the welding cable (or the welding table) and will sense when the welding starts. The dampers will automatically open and remain open as long as welding takes place. It closes automatically as welding stops. There is an over-ride control which is adjustable between 7 sec and 6 min., which will allow the damper to remain open to extract residual after-fume.

The arms also have in-built lamps in the hoods to provide task lighting. (Additional task lighting can be installed on the new booms as needed). Install new 20 hp motors with VFD drives at exhaust fans (SUN), operate these motors to maintain constant negative pressure, independent from how many exhaust air dampers are open.

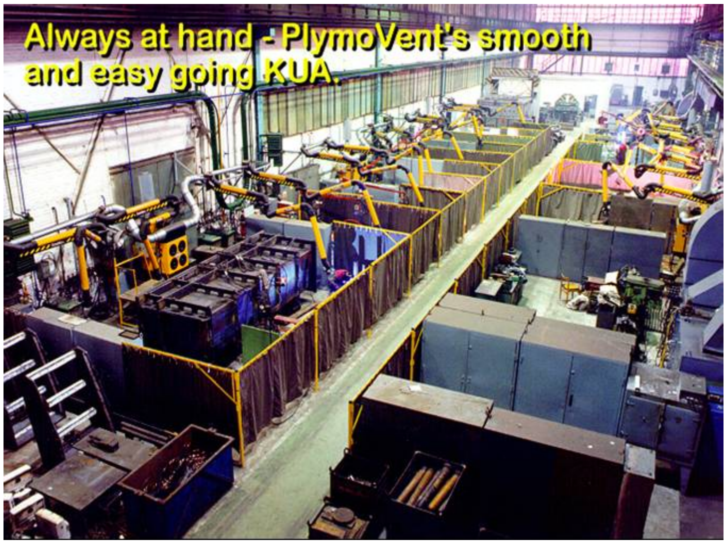


Figure 23. Articulated fume extraction arms with a built-in damper and a task light.

This system will run on its own, balancing the negative pressure in the exhaust system so that 700 – 750 cfm of exhaust air is available at every extraction arm as soon as the automatic damper is opened. Today the exhaust at existing extraction arms is anywhere between 0 and 300 cfm per arm, depending on how clogged the hood is.

Maintain the possibility to send return air back to the welding shop after the filters, at wintertime. With this operation the welding exhaust units will not influence the air pressure in the welding shop.

In summer, all exhaust air should be sent out of the building. The SUN units should also be operated by timers, on a weekly schedule, programmed with operation time in accordance with working hours in the welding shop, at present 600 am to 0.30 am, Mon – Fri. Otherwise the SUN units shall be switched off.

Savings

50% capacity reduction possible due to workload.

40% simultaneous operation makes the new, capacity controlled exhaust system, work at 20% of current energy use.

Exhaust Fan Savings:

PL1 produces 1000cfm/Hp, PL6 1320cfm/HP. Average = 1160cfm/HP

Before Use = 1Hp/1160 cfm x 30,000 cfm = 25.9 Hp

After Use = 1Hp/1160 cfm x 23,925 cfm = 20.6Hp

Savings = (25.9Hp -20.6Hp) x .746kW/Hp x (17.5Hr/day x 5day/week x 52week/yr) = 17,990 kWh/yr

Supply Fan Savings are assumed to be equal to the exhaust fan savings. Since hours of operation occur during both peak and off-peak periods, an average cost of electricity is calculated as:

((6.5 x $.0185/kWh) + (12 x .0301kWh))/(6.5 + 12) = $.0260/kWh

Heating savings

Old make up required = 30,000 cfm

New makeup air = 725cfm/arm x 33 arms x .4 = 9,570 cfm

Savings = 1.08 (Btu/°F*CFM*hr) x (72-36.6) °F x (30,000 - 9,570) cfm x (17.5Hr/Day x 4.3week/month x 5month/yr x 5 day/week) = 1,469 MBtu/yr

This measure will also improve IAQ, morale and productivity. It also solves the urgent problem regarding task lighting in the welding shop.

Investments

The total investment regarding the new exhaust arms, new motors, VFDs and pressure sensors is $121,555.

Payback

$121,555/$9,184/yr = 13.24 years

LCCA results Summary

First year savings	$9,184
Simple payback period (in years)	13.24
Total discounted operational savings	$137,430
Savings to Investment Ratio (SIR)	1.13
Adjusted Internal Rate of Return (AIRR)	3.63%

WD#2: Ventilation Improvement in Welding shop (Pressure Control)

Existing Conditions

In wintertime in the welding shop, the HVUs and exhaust fans are run as follows:

HVU-212-R-17 – R-20 (4 units) at 64,000 cfm each, are run at half speed and thus also half airflow. Thus a total of 128,000 cfm is distributed into the welding shop. The sequence of operation regarding the HVUs control the mix of return and outdoor air. When it is very cold outdoors the outdoor airflow might reach the minimum level, which is 2,500 cfm per unit, or 10,000 cfm in total. During the RIA Phase 2 visit it was noticed that the HVUs operated at 50 percent outdoor air.

The heating coils in the HVUs are designed for a maximum outdoor airflow of 18,200 cfm each at 0 °F. This means that a total of approximately 73,000 cfm of outdoor air *could* be supplied into the welding shop during the coldest days.

There are six separate roof exhaust fans that evacuate air at roof level. The fans are labelled EF-212-R-33 to R-38. Design airflow is 34,000 cfm each. These fans are today switched on or off manually from a panel close to the welding shop office. The airflow for these exhaust fans has been measured to be approximately 25,000 cfm per fan, or a total of 150,000 cfm. Anyone can switch these fans on or off. During the week of Nov. 29th to Dec 3rd these fans were always run during welding shop working hours.

With the HVUs at minimum outdoor air, totalling 10,000 cfm, and with all the exhaust fans switched ON, the total negative pressure will come from a lack of 150,000 – 10,000 cfm (HVUs) – 8,500 cfm (SUN welding exhaust units at present condition) = 130,000 cfm.

During the Phase 2 assessment week at Rock Island we measured the airflow in the door opening between the Plating shop and the Welding shop. The measured airflow was 151,000 cfm, INTO the welding shop. At that time the HVUs were run at 50 percent outdoor air (at 30 °F) which gives a total of + 64,000 cfm outdoor air at half speed, all six exhaust fans were running (- 150,000 cfm) and one of the SUN units distributed air out to the ambient, approximately - 3,000 cfm. The total negative airflow then amounted to 89,000 cfm. In addition to this there are also some small exhaust fans, seven fans at 6,000 cfm each, which were also running. Total negative airflow then amounted to approximately 130,000 cfm. This is somewhat differing from the measured 151,000 cfm, a number that has some uncertainty since air speed through the door opening was measured and calculated over a number of measuring points across the door area.

Solution

To keep the welding shop balanced with respect to supply and exhaust air we propose the following measures to be implemented:

- Install pressure sensors for indoors and outdoors air pressure.

- Control HVUs to balance exhaust and supply air. Slightly negative pressure can be allowed.
- HVUs to be controlled on temperature and pressure.
- New control cabinet for the six exhaust fans, to prevent manual operation of the exhaust fans. This cabinet should also include switches for the seven small exhaust fans, which still can be allowed to be operated manually.
- Adjust sheaves on exhaust fans for summer operation (increased exhaust airflow to match 100 % outdoor air through HVUs, i.e., 256,000 cfm, indicating that the six exhaust fans should manage to exhaust 256,000 – (7x6,000, small EFs) – 10,000 (SUN units in summer mode) = 200,000 cfm. The exhaust fans then should be adjusted to be able to exhaust 34,000 cfm each, which is what they originally were designed for.
- “Airing” mode to be programmed, allowing HVUs to run on 50% outdoor air for 30 minutes while all exhaust fans also are running, at full speed. This is for emergency situations when something extraordinary happens and there is a need for a short period of getting rid of smoke and supplying larger amounts of fresh air into the welding shop.

Mode of Operation, Winter, Working Hours (6 – 00 Weekdays)

- One exhaust fan remains in operation.
- SUN units with the new extraction arms take care of welding fumes at the source, eliminating most of the welding fumes.
- HVUs are modulated to supply as much outdoor air as is evacuated through the exhaust fan and the small exhaust fans.

Mode of Operation, Winter, Unoccupied Periods (00 – 06 Weekdays and All Weekends)

All exhaust fans are switched off.

HVUs on 100 percent return air, are operated only as needed, for heating purposes, otherwise automatically switched off.

Mode of Operation, Summer

- All exhaust fans running, all the time
- All HVUs running, all the time, full speed, 100% outdoor air. (This is for cooling reasons.)

Savings

The total negative airflow of 130,000 cfm has to be heated somewhere. Heating 130,000 cfm from outdoor temperature to 22 °C (72 °F) during weekdays 06-00 demands 3,900 MWh of steam. With the proposed new mode of operation in wintertime with only one major exhaust fan and the small exhaust fans running (if needed) there is only 72,000 cfm to be heated.

It is also proposed that the supply air temperature is reduced to 20 °C. The steam savings then amount to 2,000 MWh a year.

Heating Savings

Before 1.08 (Btu/ °F*CFM*hr) x (72-36.6) °F x 130,000cfm x 1935Hr/yr = 9617 MBtu/yr

After 1.08 (Btu/ °F*CFM*hr) x (68-36.6) °F x 72,000cfm x 1935Hr/yr = 4725 MBtu/yr

Savings = 9617 – 4725 = 4,892 MBtu/yr

Electricity Savings

Exhaust fans: five fans, 10 hp each, not running weekdays 06 – 00, 52 weeks per year: 175,000 kWh

HVU fans: Reduced operating time in winter nights and weekends: four motors, approximately 10 hp/motor on low speed, 4 hours per night in weekdays and 40 hours per weekend: 60 hrs/week for 30 weeks: 1,800 hrs x 4 x 10x 0,746 = 53,712 kWh/yr

The average cost of electricity for the periods of operation is:

((.0301 x 12 x 5) + (.0185 x (6 x 5 + 18 x 2)))/((12 x 5) + ((6 x 5) + (18 x 2))) = $.02402 kWh

Demand Savings

Summer = 37.3 kW x $9.14/kW x 4 months = $1364/yr

Winter = 37.3 kW x $4.98/kW x 8 months = $1486/yr

Total demand savings = $1,364 + $1,486 = $2,850/yr

Investment

$15,855

Payback

$15,855/$35,505/yr = 0.45 years or 6 months

LCCA results Summary

First year savings	$35,505
Simple payback period (in years)	0.45
Total discounted operational savings	$531,934
Savings to Investment Ratio (SIR)	33.55
Adjusted Internal Rate of Return (AIRR)	22.78%

Suggestion: Package this measure with the welding extraction arms. These measures are related and will give an overall good investment.

- Combine WD#1 and WD#2
  - Packaged savings: $44,689
  - Total investment: $137,410

Combined Payback

The payback period is 3.1 years

Building Envelope

From the standpoint of an energy savings, it is not (in most cases) easy to get quick payback using building envelope energy conservation measures. In Rock Island Arsenal, some buildings, particularly Building 220 are in such a bad shape that parts of the building façade fall down to the ground. The investment required to upgrade such buildings to a certain standard, without endangering the passers-by, cannot be justified based on energy savings alone. Still, something must be done to save Building 220. Willingness to spend money is a must. The energy bill will go down when the building is better sealed and insulated—as a secondary effect—but this is only a bonus, it cannot be the basis for the investment decision.

Regarding the wings of Building 220, there is no economic basis for construction of walls to separate empty floors from the crane bay. With today's mode of operation of Air Handling Units in wintertime, only 10 to 20 percent of the air is makeup air. This means that the costs of heating, by ventilation, are only $1,000 per floor per year. It is better to leave the wings open to the crane bay and to control temperature on each floor using the dampers to open whenever the temperature goes below the setpoint. By keeping the floors heated, the building is preserved and the IAQ of the crane bay occupancy zone will not be affected negatively.

Recommendations for Building Envelope

BE#1: Improving Indoor Air Quality in Summer and Winter in Building 220

Existing conditions

The large area of north wall windows is a tremendous source for heat losses during wintertime. The windows are old, single pane, metal-framed windows. The thermal losses are increased by the fact that some of the windows do not close tight. The air infiltration in this building is substantial. Underneath the windows there are unit heaters (a total of 14 units), connected to the steam system, operated manually one by one. The control of heat supply is poor. There are no modulating steam valves. The ventilation of the area is also not up to any kind of standards. The indoor air is very cold in winter and very hot in summer.

Solutions

North Wall Windows

Remove all opening mechanism at floor level (so that the remaining parts can not be easily reached by people working in building). Close all windows permanently. Secure with screws or rivets if necessary. Tighten leaking frames with weather resistant sealer. Replace broken windows (square foot size). Allow opening of the small windows at the lower part of the wall, for summer conditions, but control that the closing mechanism works.

What Will Happen if Work Is Not Done?

Outdoor air infiltrates the building, low temperature at working space, and varying temperature over time will cause difficulties with keeping machine work within tolerances. Low temperature will affect adjacent buildings and work space as well, due to open doors and varying air pressure in buildings. Building 220 has positive pressure relative to connecting buildings.

Control of Unit Heaters

Coordinate control of unit heaters: Three room temperature sensors should be installed, each of them controlling four to five unit heaters on the north wall. These temperature sensors will also be the ones that are used for heating and cooling purposes, see ventilation measures below. Control should be done by a Johnson Controls system. Centralized control is a request that can not be neglected, it is a prerequisite to avoid simultaneous cooling and heating (which happened during the second phase assessment week, 29 November– 3 December 2004)

Ventilation East

HVU 220-3-1(located on top of east entrance air lock) should be used further for heating purposes in wintertime. The unit is today connected to ventilation ducts serving the eastern part of crane bay area. It runs mostly on return air. In winter this operational mode should continue but the air intake should be up at the ceiling level. This can easily be done by installing ventilation ducts and dampers on the roof, connecting existing exhaust "openings" to outdoor air intake so that the warmest air at roof level is returned to the unit below and the warm air can then be brought back down to the occupancy zone. Temperature control shall be coordinated with the new temperature sensors in the working area. HVU 220-3-1 shall always be operated at full speed, full airflow.

For the summer case: Run HVU-220-3-1 on 100 percent outdoor air. Install one new summer exhaust fan (airflow in same range as HVU-220-1D-2, i.e., 20,000 cfm) to evacuate hot air from under the roof, close to the new ducts for extended return air in winter. This fan should be with two-speed motor so that the air pressure can be balanced, depending on how other units are operated in summertime, see below.

Ventilation West

Ventilation unit HVU-220-RE-3 is today serving areas on second floor of building 220 that are no longer in use. This unit should be used as follows: Where the supply air duct reaches roof level of second floor, just outside the balcony, the ducts shall be connected, via a new, 3m long vertical duct to the ductwork that today serves the west parts of the crane bay area. The connection to the unused areas on second floor shall no longer be in use; all the airflow from HVU-220-RE-3 shall be serving the west crane bay area.

The west bay crane area is today served by HVU-220-1D-2 which is located on a platform underneath the roof in the area west of the crane bay area. HVU-220-1D-2 shall not run in wintertime. An automatic damper shall be installed to prevent airflow going backwards, from HVU-220-RE-3, via ducts, to HVU-220-1D-2.

In summer: Both 220-RE-3 and 220-1D-2 shall be run on 100 percent outdoor air, serving the same supply air ductwork, serving the western part of the crane bay area.

On the roof: HVU-220-RE-3 shall be equipped with new ductwork and dampers so that warm exhaust air is taken from the very highest point of the crane bay and returned back into the building, down to the western areas of crane bay. In summertime the supply air shall be 100 percent outdoor air. Exhaust air from top of crane bay shall then go do the ambient, getting rid of as much heat as possible. Also this unit shall be controlled with respect to and in synchronization with the unit heaters at north wall.

Additional Measures, Building 220

HVU-220-RE-6 should be turned off. It serves areas where there are no activities going on presently.

There are four floor areas that are not in use but where the ventilation system is run as if the areas were used. They are: 4th floor middle wing; 3rd floor middle and west wings; 2nd floor west wing.

In these areas we suggest the following measures:

- Reduce exhaust air area (grid in wall) to 50% of present area.
- Install manually operated (low cost reasons) dampers in supply air ducts, adjust to 10% of today's supply airflow. This will help to reduce the positive pressure in building 220 as well.
- Reduce fan speed in accordance with these flow reductions.

As soon as a floor in a wing is vacated: Do the same thing again, adjust fan speed in accordance with changes.

Savings

Steam savings can be calculated by reducing the infiltration through the north wall windows to half of what is expected presently, using the following parameters:

- Volume in crane bay area: approximately 100,000 m^3.
- Infiltration: One air exchange per hour (which we feel is low).
- To heat 100,000 m^3/h requires 2870 MWh/year.
- It is expected to reduce this infiltration related heating need by half.

  Savings = 1.08 (Btu/ °F*CFM*hr) x (72-36.6) °F x (.5 x 100,000m^3 x 1Hr/60Min) x 35.3147 ft^3/m^3 x (168Hr/week x 5 month/yr x 4.3 week/month) = 4,063 MBtu/yr

- More savings will be gained by better control of heaters and by moving the hot air from the ceiling level to the working zones using the new ventilation system.

- These additional savings are likely to be in the same magnitude as the calculated steam savings (4,063 MBtu/yr), thus cutting the pay-back-time or allowing for higher investment costs.
- Steam savings by operating HVUs (220-3-1 and 220-RE-3) on 100 percent return air in winter, also with a higher temperature since the return air is taken from the ceiling level, can be calculated: 1.08 (Btu/ °F*CFM*hr) x (72-36.6) °F x (.5 x (11,200 + 16,800)/2)cfm x (3612Hr/yr) = 1160 MBtu/yr
- Taking HVU-220-RE-6 out of use (10,000 cfm in winter, 10 percent outdoor air, continuous operation, 5 kW):

  Steam savings = 1.08 (Btu/°F*CFM*hr) x (72-36.6) °F x (0.1 x 10,000) cfm x (3612Hr/yr) = 138 MBtu/yr

  Fan Energy Savings = 5 kW x 8760Hr/yr = 43,800 kWh/yr
- Reducing air flow in unoccupied floors as described above will save:

  250,000 kWh x 0.003409 MBtu/kWh = 853 MBtu of steam and 130,000 kWh of electricity.
- Additional savings are expected, as mentioned above, due to better control of unit heaters and by providing the occupancy zone with warm air from ceiling level, thus to a large extent eliminating the use of the unit heaters. Table 25 summarizes the investment required to control unit heaters and provide the occupancy zone with warm air from the ceiling level.

Table 25. Investment required to control unit heaters and provide occupancy zone with warm air from ceiling level.

Item	Unit	Quantity	Unit Cost	Total Cost	Notes
Unit heater controls & duct return to HVU-220-3-1	EA	1	$17,500	$17,500	
New exhaust fan	EA	1	$8,000	$8,000	2 Speed Fan With Room Temperature Control
New duct to HVU-220-Re-3	EA	1	$5,000	$5,000	Connect Duct From Hvu-220-Id-2 To Hvu-220-Re-3
Add dampers and air flow on AHUs	EA	1	$7,500	$7,500	
Seal windows and add interior glazing to north wall	EA	1	$197,000	$197,000	
Estimated contract cost				$235,000	
Contingency percent (10%)				$23,500	
Subtotal				$258,500	
Supervision, inspection & overhead (5.7%)				$14,735	
Total request				$273235	
Total request (rounded)				$273,200	
Installed equipment-other appropriations				$0	

Payback

Total Project = $273,235/$61,640 = 4.43 Years

LCCA results Summary

First year savings	$61,640
Simple payback period (in years)	4.43 years
Total discounted operational savings	$922,067
Savings to Investment Ratio (SIR)	3.37
Adjusted Internal Rate of Return (AIRR)	9.46%

Note: The suggested measures are primarily to improve indoor climate, to make working conditions bearable and to keep machines at a steady temperature so that quality measures can be maintained. Also, if necessary, this measure could later be combined with radiant heaters.

BE #2: Install High-Speed Doors Where Such Doors Do Not Exist Today

Existing Conditions

Large doors, e.g., in the large eastbound door in building 299 (shipping and goods entrance), are very slow; 30 sec up to minutes to open or close a door is common. In building 299 the particular door is said to be operated so often that it is open for 30 minutes per hour. This causes substantial heat losses in wintertime and you can feel the cold air entering far into the working areas of building 299.

Between the loading dock (south dock, with three loading docks) area and the large southern, unheated warehouse area there are four openings, 10 by 12 ft, for trucks to transport things into and out of the warehouse. The openings are covered with plastic stripes. These stripes are put up every autumn (if the personnel can find them again) and taken down every spring. The stripes do to some extent prevent cold air from moving from the cold to the hot area, and vice versa, but only to a small extent; there is a constant distribution of heat from heated to cold areas. The people working there also mentioned that the plastic stripes knock boxes off the truck, to the floor, sometimes, causing extra work and possibly also damages to the transported goods.

Solution

Install fast speed doors where large slow doors are used today, between heated spaces and outdoor or significantly cooler spaces (e.g., between the loading dock and the warehouse, not heated).

Reduce indoor temperature in Building 299. It is much too warm at several areas, especially in the loading dock and in the wood-manufacturing department close to the loading dock. Temperature set points should be adjusted downwards. This will be easy to do when rapid doors are installed; the problem causing the need for extra heat is then eliminated.

Savings

The savings depend on the frequency of the opening and closing cycles of a door. Swedish experiences from large heated warehouses show that a door that is 12 by 12 ft, open 10 min/hour, causes heat losses of over 1,400 kWh/day or 170 MWh/yr. Savings for the large door, 20 by 18 ft (open 30 min/hr): 1,250,000 kWh x 0.003409 MBtu/kWh = 4,261 MBtu/yr.

Savings for the smaller, interior doors, 10 by 12 ft, today covered with plastic stripes that are not air tight (reduced savings due to not being exposed to outdoor air, but still unheated areas to protect heated areas from):

250,000 kWh x 0.003409 MBtu/kWh = 852 MBtu. Multiply by four door openings and you get 3,408 MBtu/yr. Total Btu savings = 4,261 +3,408 = 7,669 MBtu

Major improvements can be done in indoor climate, especially since an open door affects indoor temperature over very large floor space areas when the outside temperature is very low. By installing a high-speed door you can also avoid staff taking temperature control into their own hands by bring portable electric heaters to help them warm up. This will further increase electricity consumption.

Investment

For the large door (Figure 24) in the eastern wall of Building 299: $30,000 installed. For the interior doors between heated and cold areas (Figure 25) in Building 299: $25,000 for four doors installed (Table 26).

Payback

For the five rapid doors together: $63,950/$43,106/yr = 1.48 years.

Figure 24. Large, 20 by 18 ft, rapid door, Crawford Econoroll 5000.

Figure 25. Rapid door for separating interior heated areas from cold areas Crawford Econoroll 1200.

Table 26. Cost to install interior doors between heated and cold areas in Building 299.

Item	Unit	Quantity	Unit Cost	Total Cost
High speed door – 20 X 18 ft	EA	1	$30,000	$30,000
High speed door – 10 X 12 ft	EA	4	$6,250	$25,000
Estimated contract cost				$55,000
Contingency percent (10%)				$5,500
Subtotal				$60,500
Supervision, inspection & overhead (5.7%)				$3,450
Total request				$63,950
Total request (rounded)				$64,000
Installed equipment-other appropriations				$0

LCCA results Summary

First year savings	$43,106
Simple payback period (in years)	1.48 years
Total discounted operational savings	$644,433
Savings to Investment Ratio (SIR)	10.08
Adjusted Internal Rate of Return (AIRR)	15.61%

Comment

In the Phase 1 report, it was suggested to install rapid doors in building 220. With the measures suggested in this Phase 2 report concerning pressure control to balance airflows in different buildings and also the suggested measures regarding building 220 in terms of improved heating and ventilation, the previous suggestion is hereby dropped since there is no longer a need for installation of these rapid doors.

Building HVAC Systems

Johnson Controls Inc. (JCI) is responsible for the operation of most of the HVAC systems and in many cases these are computer supervised and scheduled. Some units are not remotely controlled or supervised; this results in large negative pressures and other problems. In most AHUs, the steam valves are modulating and working properly. However, this is not the case in the Plating Shop; the steam valves do not work very well in this location, even though the JCI operated systems generally are well maintained.

The Arsenal's existing HVAC systems were generally designed to provide ~ four air exchanges with outdoor air per hour. This air exchange rate provides acceptable thermal conditions during hot summer days. During wintertime, AHUs in many cases operate with only 10 percent of outdoor air (in theory, probably more in practice since dampers are not that accurate). This saves energy for heating.

Although the airflows are high, the systems do not function properly. Fresh air is supplied at the wrong places, too high up to reach the working zones, too far away from where it is needed, or at the wrong temperature. This results in upward airflows that prevents the air from reaching the work zones below. Short circuits in ventilation between supply and exhaust air result in poor ventilation efficiency. IAQ is not as good as it can or should be.

Recommendations for the Building HVAC Systems Operation

Air Balance and Pressure Control

During the Phase 2 assessment week, measurements and calculations of air movements and air balances were made for the RIA industrial complex buildings. The results are presented below:

Air Movement

From Building 220 to other buildings: Air velocity 1.9 m/s gives 40 m^3/s which equals 85,000 cfm.

From 211 to Plating: 3,8 m/s, 53 m^3/s, 112,000 cfm.

This air comes from: Open doors or leaking doors in the loading area between 211 and the Plating shop; Heat Treatment Building 222; Building 211; also from Building 220 (to some extent since all buildings communicate, via open doors).

From plating to welding shop: 3,4 m/s, 71,5 m^3/s, 151,000 cfm. This means that there is a positive balance in plating shop, approximately 39,000 cfm which makes sense if we calculate all system air flows that are running in the plating shop including those from MAUs, non-scrubbed exhaust fans and scrubbers.

From the ramp between Building 211 and Building 208: 3 m/s, 48 m^3/s, 102,000 cfm.

Air Balances

Welding Shop: Supply air 64,000 cfm. Exhaust 150,000 + 42,000 cfm. Total negative balance: approximately 130,000 cfm. The airflow to adjust for the negative pressure comes from the plating shop (151,000 cfm) and the foundry (not measured). The differences come from uncertainties in the measurements of the air movements and also the measurements regarding the six large exhaust fans in the welding shop. These numbers could easily be off by 20 percent, indicating that the total exhaust through those fans are not 150,000 fm but 180,000 cfm, thus balancing the equation.

Building 211: Supply air with 50 percent outdoor air: 42,000 cfm. Exhaust air: 13,000 cfm. Total positive balance: 29,000 cfm

Building 208: Except painting area, supply air with 15 percent outdoor air: 31,000 cfm.

Building 208: In the painting area, supply air with 15 percent outdoor air: 15,000 cfm. Exhaust air in the two paint booths: 161,000 cfm (22 °C, 71 °F). Additional exhaust from Paint Booth No. 3: 30,000 cfm. Negative balance: 176,000 cfm.

Total, Building 208: 176,000 – 31,000 cfm = 145,000 cfm (compare with air movement in ramp between 211 and 208: 102,000 cfm, which is a significant difference indicating that it is not easy to get correct measurements over the whole area).

Comments

Depending on system operation mode, the different buildings are under either negative or positive pressure as compared to outside or adjacent buildings. This means that dynamic air movements could be enormous, transporting cold or warm air, polluted or fresh air. The systems also try to suck air in or push air out through walls, windows, doors etc.

Solution

Using the Welding shop ventilation and air balance situations described above as an example, there are solutions to the large in-balances and the problems they cause. The solution is called pressure control and the following describes how it is done:

- Install pressure sensors for indoor and outdoor air pressure.
- Control HVUs to balance exhaust and supply air. Slightly negative pressure can be allowed.
- HVUs to be controlled on temperature and pressure.

- HVUs should be run for heating purposes, as needed, during non-occupied periods, then working on 100% return air.

Solutions have been proposed to take care of the systems in the Plating shop and the Welding shop. Also measures were suggested for the Heat treatment shop in Building 222.

The remaining unbalanced systems, in Buildings 220, 211, and 208 could also be solved, but not completely due to massive negative pressure in Building 208, especially when the paint booths are used. Of course, the percentage of outdoor air could be increased in the HVUs in Building 208 and also in Building 211 to match the paint booth exhaust flows but this will also increase the total steam-based energy that is needed. It is therefore suggested the following solutions to the systems in Buildings 208, 211, and 220:

- *Building 220:* Suggested measures will reduce the positive pressure. No other measures are being proposed here.
- *Building 208:* Proposed measures regarding control of airflows in paint booths will solve the air balance problem during most of the time, i.e., when the paint booths are not operated with full exhaust airflow. During painting operations, there will be a large negative pressure. It is suggested that Building 208 is left without further measures being supplied from Building 211 and being under whatever negative pressure that is being built up from time to time. No complaints or problems related to the negative pressure in Building 208 was heard, so it is felt that at this stage no further actions are required.

  An option might be, if felt necessary: HVUs to be equipped with a new control system to facilitate increased outdoor airflow during the periods when painting is done. Pressure sensors to be installed or, easier, to connect also the HVUs to the signal from the air guns in the spray booths so that they ramp up to a pre-specified outdoor air ratio as the air gun signal arrives.
- *Building 211:* It is suggested to leave Building 211 as it is today, creating a slight positive pressure in wintertime, supplying the needs also in Building 208. An option was to install a pressure control system, as described above, to match HVUs with exhaust fan operation.

Savings

Savings have been calculated for plating shop, welding shop, for Building 220 and for optimised spray paint booth operation (controlling exhaust airflow). No further energy savings can be calculated as a result of the measures that were proposed here.

Investment

Building 220: No further investment.

Building 208: No further investment. Option: $5,000 for air gun signal input and reprogramming.

Building 211: No further investment. Option: $10,000.

Payback

In combination with other suggested measures, seeing the whole picture and considering the investments as a packaged solution, the payback time is very low (within 2 years).

BH#1: Improve Ventilation in RRMC, Rapid Response Manufacturing Cell

Existing Conditions

The Rapid Response Manufacturing Cell is located between buildings 208 and 211. It is a fairly new department with modern manufacturing capabilities. The facilities suffer from very high indoor temperatures in summertime, which also was noticed and verified during our visit at RIA during the week of the Phase 1 energy audit. The RRMC is ventilated by three Air Handling Units, taking the supply air in separate air intakes faced down towards the black roof (2 ft over the roof surface). The roof temperature when the sun is shining was measured to 115 °F. The roof is lower than the roofs of buildings 208 and 211, which reduces air speed by wind; the RRMC roof is sheltered from the wind.

The AHUs also have the possibilities to circulate indoor air back into the facilities, during wintertime when heating is more crucial. It was noticed that the dampers that were supposed to be in summer position, i.e., closed for air circulation and 100 percent open for outdoor air intake, did not work properly. One AHU was fully open for both outdoor and indoor air to mix the supply air, one was half open for indoor and fully open for outdoor air, the third one seemed to work properly. (Note: This was fixed when the assessment team came back for Phase 2 work.)

Solution

Install new air intakes for all three units, HVU-208-R-9 – R-11. Air intakes should be ending 12 – 14 ft up, easiest way to fasten the intakes is at building 211 wall.

Silencers should be installed directly after the HVUs 208-R-9 and 208-R-10. After the silencer new ducts, horizontally mounted spiral ducts with the diffusers as punched nozzles in the duct (Fläkt Woods' system Activent or similar, Figure 26) should be installed, in the center of the RRMC working area, directed south and north from each unit. (Air distribution should occur above clean areas, not directly above machines). Exhaust air to be remained as today.

Figure 26. Fläkt Woods Activent duct/diffuser.

These measures are intended to decrease temperature of supply air in summer (get away from the black roof) and to get a quieter, more uniform air distribution pattern within the working area. The punched ducts are perfect for distribution of supply air with a temperature around 3 °C (5 – 6 °F) below room temperature and will thus provide the working area with cooling effect.

This should be the first step and it is highly believed that these actions will strongly improve summer IAQ and working conditions in the RRMC area.

Second step can be to increase fan speed of the two HVUs.

Third step can be to "borrow" supply air from adjacent building 211 where supply airflow in summer is more than enough as it is today.

Savings

This is mainly an issue related to improving indoor air quality, which will lead to higher productivity. Energy savings are negligible if you do not count avoided investments regarding cooling units to make working conditions acceptable, which could be a fact if nothing is done regarding the ventilation system and number of air exchanges. During Phase 1 assessment the cooling requirements were mentioned as one possible solution for RRMC IAQ and working conditions. The suggested measures will also eliminate the needs to run the single standing fans that are being used now to make air move and thus create a cooling effect.

Investments

Total investment required to install new air intakes for all three units is $17,400 (Table 27).

Table 27. Investments required to install new air intakes for all three units.

Item	Unit	Quantity	Unit Cost	Total Cost
Modify AHU intakes and add silencer	EA	1	$12,000	$12,000
Add active NT ducts	EA	1	$3,000	$3,000
Estimated contract cost				$15,000
Contingency percent (10%)				$1,500
Subtotal				$16,500
Supervision, inspection & overhead (5.7%)				$940
Total request				$17,440
Total request (rounded)				$17,400
Installed equipment-other appropriations				$0

Payback

With respect to existing conditions in the RRMC, it is expected that the pay-back is immediate with respect to savings from increased productivity, reduced material waste and avoided rework

BH#2: Exchange VAV Boxes and Improve Control Equipment in Offices in Administrative Buildings

Existing Conditions

The administrative offices have pneumatically controlled VAV (Variable Air Volume) boxes and thermostats. The VAV boxes are constantly out of calibration because of inadequate resources to maintain them properly. The air compressors and dryers are high maintenance equipment and are energy inefficient. The productivity of office workers is affected during hot summer days when comfort levels cannot be properly maintained.

Solution

Where temperatures are difficult to control install digitally controlled actuators for modulation of the dampers in the VAV boxes. Provide new thermostats and control the dampers using a 0 – 10 V signal between minimum and maximum damper positions. This will eliminate VAV box calibrations problems and the need for conditioned compressed air. Temperature control will improve greatly and a comfortable working environment will be provided

Savings

This recommendation should be reviewed for saving potential in the future. Areas that are experiencing uncontrolled temperatures are good candidates for this control system upgrade. Those spaces that are excessively too warm waste steam heat and should be made more comfortable with a new VAV control system.

Investments

The required investment to implement BH#2 has not been determined.

Payback

Not possible to calculate at this stage.

BH#5: Install Separate Cooling Unit for Recoil Assembly and Machine Shop Area in the Basement of Building 208

Existing Conditions

In the basement of building 208, northwest part, the indoor air climate is controlled with respect to temperature and relative humidity. This is required all year round 24-7. Cooling water is provided from the chiller on platform 2 in building 211. The cooling water travels over a very long run. This causes cool losses that are adding to the overall energy bill.

The chiller was thought to be oversized when on winter use, thus running on/off with very short intervals to cover the relatively small cooling load far away. New information has revealed that the chiller is not in use during the winter. The area is conditioned using cold outside air. The chiller is turned off in winter; at the visit to Rock Island it was down for maintenance and we could easily see that it was not running. Since production continued as usual we believe that there is no need for space cooling from the chiller in the winter.

Solution

This initially suggested measure is hereby dropped, due to new facts.

BH#6: Install On/Off Dampers in Supply Air Ducts on Every Floor in Building 220, Wings 1–3

Existing Conditions

Manufacturing workspace consolidation is under way to move out of various floors in the wings of Building 220. When each floor is emptied, the need to ventilate the space is eliminated, except for heating purposes since the heat is provided by the ventilation system. Annual costs to heat and ventilate every separate floor today are about $1,000 per floor for steam and $4,000/year for electricity (see Note below) to run AHUs (Air Handling Units).

Solution

Install manual (or automatic) dampers in the supply duct on every floor. Cover half of the area of the exhaust air intake on every floor. If there is no VFD on the Air Handling Unit, exchange belt pulleys to reduce airflow. With VFD: Control dampers to open when temperature gets below the setpoint and to heat to the appropriate temperature. Close dampers when the proper temperature is reached. VFD controls fan speed to keep constant positive pressure in supply air ducts. Filter exchange savings can also be counted on.

Savings

Savings are calculated per floor after airflows change.

Steam savings: $500/yr

Electricity savings: $2,000/yr

Investments

Required investments to implement BH#6 include:

- installation of dampers
- plates over exhaust air intakes
- VFD(s), or changing belt drives, for a cost (without VFDs) of $2,000/floor, or (with VFDs), $6,000/floor.

Payback

The estimated payback period for implementing BH#6 is 2.4 years (with VFD) or 10 months (without VFD).

Note

Assuming one AHU per wing, 64,000 cfm, divided by five floors, and 20 percent outdoor air during heating period, calculates to 130 MWh/year and floor:

130 x $8/MWh = $1,040.

Electricity: assuming 64,000 cfm = 109,000 m^3/h or 22,000 m^3/h per floor. SFP = 2.5 $kW/m^3/s$ and operation for 7,000 hrs gives:

22,000/3,600 x 2.5 x 7000 x 0.041 = $4,300/year.

BH#7: Install Heat Recovery Coils in Paint Booth in Building 299

Existing Conditions

There are two painting systems in Building 299. The exhaust from system #4 paint booth is at room temperatures and not hot enough to economically recover any heat. The oven system recirculates air with approximately 8,000 CFM being exhausted outdoors. The oven is kept at 130 °F which is too low to provide enough savings to pay back the cost of a heat recovery system. Savings is estimated to be $3,400 per year with a year round operation.

The other painting system #5 has a combination booth and oven. Rather than recover heat from the exhaust it is better to recirculate a large percentage of the exhaust back through the oven during drying operations. Recommendation PN#3 & #4 addresses this opportunity.

Solution

See PN#3 & #4 for the recommended solution.

Savings

See PN#3 & #4.

Investments

See PN#3 & #4.

Payback

See PN#3 & #4.

BH#8: Improve Indoor Air Quality in Building 299 Manufacturing Departments

Existing Conditions

Building 299 is used increasingly for manufacturing. The building does not have ventilation systems to provide acceptable working conditions with the type of production that is taking place there. This causes pollution of indoor air from machine operations, vehicles driven inside the building and a car wash. Since the building initially was a warehouse there is not enough exhaust systems to evacuate hot indoor air during summer, which causes very high indoor temperatures. Air conditioning units, supplying offices with cold air, have their condensers on internal roofs, providing even further heat to the manufacturing areas.

Solution

Install separate exhaust air fans on roof to evacuate heat during hot summer days. Install local exhaust systems, including fans and ventilation ducts, to withdraw polluted air from machines, welders and grinders in the "Tool Set" area. Flexible arms should preferably be used, as well as pressure controlled exhaust fans to allow varying workload.

For vehicles, the "cigarette type filters" used by the automotive industry, are suggested.

These filters are put into the vehicle's exhaust pipe and removed when the vehicle leaves the building. This is a very cheap and effective way to handle the emissions from the vehicle engines. The filters are available in three different sizes, depending on type of vehicle and size of engine. (Their products are widely used in the automotive industry.) †

Move AC condensers to the outside roof (from the "inside roof" of the offices).

Switch off lighting in the huge, cold warehouse, especially in daytime when outdoor light is good enough for most purposes. Where appropriate, install day-light sensors for automatic on/off control.

Savings

The savings come from improved IAQ and better working conditions leading to higher quality and productivity. Energy savings (except regarding lighting control) cannot be counted for since this is a building without ventilation and increased ventilation always increases the energy needs. Avoided investments regarding cooling capacity, can be counted upon. Daylight sensors for control of lighting in large warehouse areas, in combination with occupancy sensors, normally have pay-back time in the order of less than 1 month.

Investments

To be determined but this can be done at very low costs. Table 28 lists the cost for filters.

Table 28. Filter costs.

Product	Cylinder volume	Per filter	No. of starts
EHC P15	Maximum 5.5 litre engines	Initial $91	> 75, diesel
P15 replacement filters		$55	
EHC P15 cone		$101 per cone	
EHC L20	Maximum 16 litre engines	Initial $750	> 100
L20 replacement filters		$145	

With the possibility to use these filters several times the costs per start (vehicle going into building 299) is between $1 and $3 depending on the size of the filter needed.

† See enclosed information about these filters from EHC-Teknik AB in Sweden, also available at www.ehcteknik.com/frames.html and at www.sourcetecindustries.com/main/automotive

Payback

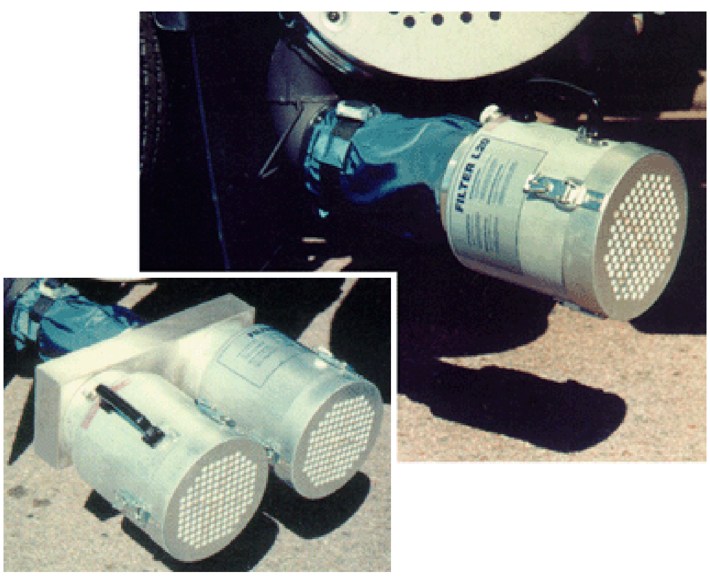
It is not possible to calculate since there are no energy savings, except for the lighting measure. Bearing in mind that the workload is increasing in building 299, the working conditions should be improved accordingly to increase morale. This means that the exhaust air systems, both for source capturing and for the removal of excess heat in summer, need to be installed. This is a matter of taking care of equipment and to protect workers from unwanted pollution.

BH#9: Perform Further Energy Savings Measures in Building 222

Existing Conditions

In the forging area of Building 222 there are three air-cooled air compressors (Figure 27) that can discharge the heated air into the forging area space. During our visit in Phase 2, there was a need for heat in the area but the warm air from the air compressor cooling units was blowing outside instead of into the building. The building's HVUs were operating with outdoor air although there are almost no people working in that part of Building 222. During low heat treat operating levels there is no need for additional HVU fresh air when the air compressor cooling units are functioning properly.

Table 29. L20 exhaust filter technical data.



For driving inside buildings reduces in room:

Particle separation	over 99.9%
CO separation	~ 30%
NOx separation	~ 60%
RC HO separation	~ 90%
HC separation	~ 35%
Max. engine. L20	16.0L
Max eng. L20 double	35.0L
Max. rpm	1200 rpm
Max. const. temp	200 °C
Max. temp 30 sec.	300 °C
Starts, dies., L20 12.0 l	over 50
Weight:	
L20	5.0kg
L20 double	11.0kg

L20 meet Technische Regeln für Gefahrstoffe [Technical Rules for Dangerous Materials] (TRGS) 554 and Control of Substances Hazardous to Health (COSHH) regulation.

The filter cartridge is disposable in normal industry waste.
Data on Exhaust filter for driving inside buildings, for large vehicles.

Figure 27. Three Air Compressors in Building 222.

Also, only one air compressor was observed operating with no forging being accomplished. Currently the level of forging is low and these air compressors mainly support the main compressors by keeping the line pressurized in the heat treat building.

The compressor cooling units are located on a mezzanine above the compressors. Air is discharged from these units at an elevation of approximately 18 ft across an aisle to the rest of the area as shown in Figure 28. There was no one working in the area at the time of the field survey and the building was comfortable with the current system.

During the summer field survey, the process cooling system was examined. Three cooling towers are used to cool a number of items in the heat treat area. They provide cool water to a tank; out of this tank water is pumped to the items requiring cooling. The pumps to the cooling towers run continuously, but could be operated more efficiency through the use of a thermostat that would shut down the pumps when the tank water is cool enough.

Solution

Install thermostats in the cooling tank and operate cooling tower pumps when required.

Figure 28. Air Compressors with air-cooled heat exchangers above.

Savings

By reducing the operation of one 30 hp pump motor to half time, energy savings =

30 Hp x (8760 hr/yr x .5) x .746 kW/Hp = 98,024 kWh/yr.

Investments

Installation of the thermostats will be approximately $2,642.

Payback

$2,642/$2,219/yr = 1.19 years.

LCCA results Summary

First year savings	$2,219
Simple payback period (in years)	1.19
Total discounted operational savings	$33,491
Savings to Investment Ratio (SIR)	12.68
Adjusted Internal Rate of Return (AIRR)	16.95%

Lighting

Rock Island Arsenal has recently completed a retrofit of its entire lighting inventory replacing all of its incandescent, fluorescent and high intensity discharge (HID) lamps (Figure 29), and where applicable the associated magnetic ballasts, with energy efficient lamps and electronic ballasts. The bulk of this facility's lighting is provided by 4-ft, 32 watt T8 lamps, in one, two, three, and four lamp fixtures. At the time of the retrofit, these were one of the most efficient lamp types on the market, drawing significantly less power than the lamp type they replaced, the 4-ft 40W T12. In addition to requiring less wattage, T-8 lamps have dimming capabilities and often have a longer rated life than T-12 lamps. T-8 lamps also eliminate the flicker often associated with traditional T-12 fluorescent lighting.

Figure 29. Building lighting with new high intensity discharge (HID) lamps.

Recommendation for Lighting

LT#1: Install Spot/Task Lamps in Areas that Require Additional Illumination

Existing Conditions

The Rock Island Arsenal has a number of areas that are illuminated by a combination of high bay lighting and task lighting. For some of these areas, chief among them the Welding Shop, there is not enough light near the work area to provide proper illumination. The employees at Rock Island Arsenal have requested the purchase and/or creation of portable lighting stations that will allow workers to add concentrated task (spot) lighting to operations that require more illumination than normal. The requirements for these lighting stations, as detailed by both maintenance and operational staff at Rock Island Arsenal, are as follows:

- small in size
- portable (wheeled)
- locking casters
- durable
- able to provide illumination in a variety of directions
- easy grip handles to position light
- able to connect to 120v sources
- organic 50 to 100-ft extension cord
- light must not create a lot of heat.

Solution

As there are no portable light stations on the commercial market, the units will have to be built from commercially available equipment and pieced together to form the final desired product. The major components of the portable lighting stations will be (a) a mobile height adjustable workstation, which will support a (b) friction clutch arm, which will have on its end a (c) high lumen output lamp. The workstation will have a (d) 120V power supply and a (e) extension cord to connect to Rock Island Arsenal power sources.

The goal of this project is to increase the amount of illumination for tasks, reducing the operating time and defects, with an increase in overall quality while decreasing throughput time. This will result in decreased operating costs.

Descriptive Scope

This project consists of purchasing portable lighting stations for use in the welding, grinding and other shops where additional light has been requested by Rock Island Arsenal employees. This action will result in additional energy consumption, but it is expected that this will more than offset by increased employee productivity and quality of work.

Savings

This project is based on a comprehensive engineering study of industrial operations at Rock Island Arsenal and the premise that increasing illumination will increase both workmanship and quality while reducing throughput time, all of which will lead to decreased operating costs

Savings Calculation

Using a number of workers equal to the number of workstations requested, the annual salary of an RIA employee ($60,000) and an estimated 2 percent productivity savings, the initial annual productivity savings are calculated as follows:

(50 workers) × ($60,000/worker) × (0.02) = $60,000/yr

Assuming that each workstation will have a 400W lamp that, along with a ballast, will consume 480W, and that each workstation will operate 8 hours/day, the annual energy cost of operating the workstations will be:

(50 work stations)×(1 lamp + ballast/work station)×(480W/lamp + ballast)×(8 hr/day)×(5 day/wk)×(52 wk/yr)×(1 kW/1,000W) = 49,920 kWh/yr

The total savings are then the initial annual productivity savings less the annual energy cost of operating the workstations.

Investment

Total investment is $72,087 (Table 30).

Table 30. Investment cost estimate.

Item	Unit	Quantity	Unit Cost	Total Cost
Lighting stations (50 total)	50			
Purchase of mobile workstations	EA	1	500	$25,000
Purchase of swing arms	EA	1	300	$15,000

Item	Unit	Quantity	Unit Cost	Total Cost
Purchase of lights	EA	1	100	$5,000
Purchase of power supplies and extension cords	EA	1	100	$5,000
Assembly of components into portable light stations	EA	1	240	$12,000
Estimated contract cost				$62,000
Contingency percent (10%)				$6,200
Subtotal				$68,200
Supervision, inspection & overhead (5.7%)				$3,887
Total request				$72,087
Total request (rounded)				$72,100
Installed equipment-other appropriations				$0

Payback

The simple payback of this project is calculated to be $72,100 / $58,870 = 1.2 years or 15 months, based on the costs of creating the lighting stations as compared to the productivity savings that is expected to result.

LCCA results Summary

First year savings	$58,870
Simple payback period (in years)	1.22
Total discounted operational savings	$888,892
Savings to Investment Ratio (SIR)	12.33
Adjusted Internal Rate of Return (AIRR)	16.79%

Coal-Fired Central Boiler Plant

The coal-fired central boiler plant was built in 1918. It originally had eight retort boilers, and there was a tall brick stack located beside the heating plant on the east side. These boilers have since been removed as well as the tall stack. Now the heating plant has four boilers and four stacks located on top of the heating plant.

The total heating capacity of the heating plant is 400,000 lb per hour. The present peak steam load in the winter is about 130,000 lb per hour. It only requires two boilers to operate at that capacity. During the winter, one boiler, either number 1 or 2, is base loaded to about 50,000 pph and the second follows the trend of the steam load. Boiler 4 is considered the summer boiler. The boilers produce 135 psig, 358 °F saturated steam. No superheated steam is produced. The fourth boiler operates while the other three are renovated during the summer, and it is the last to be renovated at the summer's end. The heating plant has a system radius of about a half mile and heats about 54 buildings. A series of steam lines in the basements of the stone buildings and a number of steam tunnels connect various buildings with the central heating plant. The heating plant produces steam for heat, manufacturing, cooking (indirectly), steam cleaning in the factory, and operation of absorption chillers that produce chilled water for air-conditioning. The heating season contractually starts 15 October and ends on 15 May each year.

The softener (water treatment) room was later renovated in the 1960s and a hot zeolite lime/soda ash system was installed. A newer hot zeolite system was installed in the late 1980s to further improve the water treatment. This system resulted in water purity to 1 ppm, and virtually no scale builds up in the boilers. This results in higher efficiency, reduced maintenance, and improved reliability.

In about 1980, the baghouse, located on the north side of the heating plant was installed. It was not properly designed, and it resulted in several years of follow-up work to correct its design problems. In that same timeframe, a manufacturing renovation project, REARM, occurred and the need for additional steam capacity was questioned. A consultant was hired to determine if a fifth boiler would need to be added to the heating plant. The consultant provided a report that resulted in recommendation to improve the capacity and reliability of the existing four boilers rather than adding a fifth boiler. It took about 8 years, $2 million, and almost a full time engineer to implement about 40 contracts to make all of the changes, repairs, and improvements.

At the time of the consultant's study, it was impossible to have any of the boilers operate over 50 percent capacity without becoming unstable and having to shut the boilers down. The heating system was in a constant crisis mode because funding and emphasis for maintenance had been lost. The cost to install a now boiler was about 35 million dollars. The value engineering savings for this approach was about $33 million, in addition to filling the need for a system that operated properly. One of the improvements included changing the controls to direct digital control. We were nearly the first in the Army to do this. Employees with the authority can observe the operation of the heating plant online. Because we did not add a new boiler, we have been operating under an EPA grandfather clause regarding emissions. If RIA had added a new boiler, it would have been required to have a full time chemist and to treat all emissions for NOx and SOx. In case the EPA may review and change its policy toward "grandfathered" heating plants, CERL also considered RIA heating plant for a demonstration project for reducing emissions. (CERL later dropped the project because of funding problems). Furthermore, there are concerns regarding for the general age of the plant, and the stoker boiler industry's support for spare parts. Stoker boilers are old technology, and the industry supports only a few remaining plants.

RIA has requested funding for a study to look in the future for its heating plant and to consider making the changes required to have a reliable source of steam and heat for the Arsenal. In the past week (at the time of this writing), boiler performance tests were conducted. All four boilers were proved to be reliable again at 25, 50, 75, and 100 percent capacity. In 1980, this would have been impossible. In general, our heating is in excellent condition and a vigilant effort is continuously made to keep it that way. When a problem occurs, an individual job order (IJO) is submitted to make the repairs or changes. The most serious IJO at the time of this report is the repair of the coal elevator. The replacement of the elevator chain is being considered an emergency repair. This was identified in a required yearly review by a manufacturer's representative of the elevator company to look at the condition equipment. The chain will be repaired before the heating season starts.

The heating plant was contracted out in FY1987 after many of the improvements had been implemented or started. If these improvements had not been made, contracting would not have been possible. The contract has been rewritten about three times since that time, and the contract is considered a success.

The heating plant burns bituminous coal that comes from either Kentucky or Indiana, presently about 28,000 or less tons of coal each year. The coal consumption has been dropping for various reasons. It did have a constant 40,000-ton consumption for many years. Changes in efficiency at the plant, energy efficiency projects, reduced load due to production changes, building closures, and warmer weather have resulted in reduced coal consumption.

RIA burns coal with reduced sulfur content, and with a heating content of about 13,000 BTU per lb. The cost of coal has been increasing, from a stable $45 per ton to $56, and recently to $78 per ton due to the natural gas crisis. The coal cost estimate for FY 2003 (POl-7351) was based on $56.89 per ton for 28,000 tons having a total cost of $1,592,920.

The heating plant has about 20 employees that, in total, work 24 hrs/day 7 days/wk. All the employees are trained, are required to personally own a library of heating plant training literature, and are licensed through National Institute of Uniform Licensing of Power Engineers. All the employees have certification level of fourth class and the foreman has a required rating of first class. They are encouraged to continuously advance their certification.

Recommendation for the Coal Fired Central Boiler Plant

BL#1: Upgrade the Deaerator Tank

Originally, this recommendation consisted of upgrading the deaerator to eliminate the steam lost to venting and to preheat feedwater. After further study and information gained from RIA Public Works, it was determined that the suction head on the feed pumps was not designed properly and required a "$1,000,000 insurance fix" to get right. RIA Public Works has taken the position that changing the pressure in the deaerator (thereby changing feedwater pressure) would not be advisable. Therefore, no further study of the deaerator tank upgrade is planned at this time.

4 Summary, Conclusions, and Recommendations

Summary of ECMs

Table 31 lists the ECMs resulting from this Level II analysis.

Table 31. Level II Analysis summary of ECMs

ECM	Description	Investment (K$)	Savings (K$/yr)	Payback (yr)	Savings Category	Recommended Funding Sources
PL#1A, Ph 1 only	Install and test two EED on chrome plating tanks	153.5	33.6	4.57	E, M	ECIP
PL#1, Ph1 & 2	Install EED on all chrome plating tanks	984.8	251.7	3.91	E, M (S&H)	ECIP
PL#2	Control airflows and steam heating	212	82.9	2.56	E	ECIP
PL#3	Insulate hot plating tanks and rinse tanks	101	9.6	10.53	E	ECIP
PL#5	Allow hot plating and rinse tanks to cool down	2.5	5.2	0.48	E	ECIP
PL#6	Retrofit MAUs with low pressure drop filters	85	8.1	10.40	E, M	ECIP
PN#1	Enclose Drive-Thru Paint Booth #1 in Bldg. 208	79.8	21.0	3.79	E (P)	ECIP
PN#2	Enclose Drive-Thru Paint Booth #2 in Bldg. 208	132.4	21.3	6.23	E (P)	ECIP
PN#3	B299 Paint Booth 4 improvements	145.9	114.7	1.27	E (P)	ECIP
PN#4	B229 Paint Booth 5 improvements	49.7	63.1	0.79	E (P)	ECIP
HT#5	Heat Treat Ventilation Improvements	168.6	4.6	36.6	E (IAQ)	ESPC
FD#2	Improve ventilation in the foundry	TBD	TBD	TBD	E (S&H)	ESPC
WD#1	Install ergonomic extraction arms	121.6	9.2	13.24	E (IAQ,P)	ECIP
WD#2	Install Improved ventilation system	15.9	35.5	0.45	E (IAQ,P)	ECIP
BE#1	Improve B-220 working conditions and IAQ	273.2	61.6	4.43	E (TC)	ECIP
BE#2	Install high-speed doors where necessary	64	43.1	1.48	E (TC)	ECIP
BH#1	Improve ventilation in Rapid Response Mnfc. Cell	17.4	high	quick	E	O&M
BH#6	Install on/off dampers in B-220 supply air ducts	6	2.5	2.4	E	O&M
BH#8	Improve IAQ in B-299 manufacturing departments	low	high	quick	E (IAQ)	O&M
BH#9	Perform further energy savings measures in B-222	2.5	2.2	1.19	E	ECIP
LT#1	Install Task Lamps in Areas reqr. additional. Lighting	72.1	58.9	1.22	E (P)	ECIP

ECM	Description	Investment (K$)	Savings (K$/yr)	Payback (yr)	Savings Category	Recommended Funding Sources
FD#1	Replace critical foundry equipment in B-212 W	744.1	354	2.1	P	WC
MC#2	Cr grinding machines exhaust systems improvements	30	TBD	TBD	S&H	Fund prototype development
HT #6	Heat Treat smoke control local exhausts	TBD	TBD	TBD	S&H	Fund prototype development
18 ECMs	Total of the economically quantified ECMs including PL#1 Phase 2 work	3261.1	1149.2	2.84	ALL	ALL
15 **ECIP ECM** with PL#1 Ph1 and Ph 2	Total of the economically quantified ECIP ECMs	2342.4	788.1	2.97		ECIP
15 **ECIP ECM** but No PL#1 Phase 2	Total of the economically quantified ECIP ECMs, but no PL#1 Phase 2 work	1511.1	570	2.65		ECIP
Note: TBD=To be determine; E=Energy; M=Maintenance; S&H=Safety & Health; IAQ=Indoor Air Quality; TC=Thermal Comfort; P=Productivity; ECIP=Energy Conservation Investment Program; ESPC=Energy Savings Performance Contract; O&M=Operation & Maintenance; WC=Army Working Capital Fund;						

LCCA Results for ECIP ECMs

Table 32 lists the LCCA results for the 15 ECIP ECMs. These results can be used by the Arsenal to prepare the DD1391 form for FY07 Army ECIP funding application. An Army ECIP Guidance issued in April 2005 is presented in Appendix C with detailed program description and instructions for funding application.

Table 32. LCCA results for the 15 ECIP ECMs.

ECM	Total Investment	First Year Savings	SIR	AIRR	Simple Payback (yrs)	Annual Usage Savings (Cost)	(MBtu)
						Coal	Electricity
PL1A	$153,480	$33,556.0	3.84	10.2%	4.57	1,665	1,046
PL2	$211,960	$82,903.0	5.87	12.5%	2.56	7,908	5,802
PL3	$100,959	$9,590.0	1.42	4.8%	10.53	1,708	0
PL5	$2,511	$5,222.0	31.09	22.3%	0.48	930	0
PL6	$84,831	$8,159.0	1.45	4.9%	10.4	0	888
PN1	$79,760	$21,034.0	3.95	10.3%	3.79	2,972	655
PN2	$132,430	$21,253.0	2.4	7.6%	6.23	3,122	492
PN3	$145,860	$114,675.0	11.79	16.5%	1.27	13,386	529
PN4	$49,650	$63,114.0	19.01	19.3%	0.79	10,971	228
WD1	$121,555	$9,184.0	1.13	3.6%	13.24	1,469	123
WD2	$15,855	$35,505.0	33.55	22.8%	0.45	4,892	779
BE1	$273,235	$61,640.0	3.37	9.5%	4.43	10,277	593
BE2	$63,950	$43,106.0	10.08	15.6%	1.48	7,677	0
BH9	$2,642	$2,219.0	12.68	17.0%	1.19	0	335
LT1	$72,087	$58,870.0	12.33	16.8%	1.22	0	(170)
Total	$1,510,765	$570,030.0	10.19	16%	2.65	66,977	11,300
Note: All Analysis Based On 20 Year Life							

Table 32 (Cont'd) LCCA Results for the 15 ECIP ECMs

ECM	Discounted Savings (Cost) Over Project Life					
	Coal	Electricity Usage	Electricity Demand	Total Energy (Excludes Demand Savings)	Non-Energy	Total Operational Savings
PL1A	$139,766	$104,725	—	$244,491	$345,320	$589,811
PL2	$663,824	$581,005	—	$1,244,829	—	$1,244,829
PL3	$143,375	—	—	$143,375	—	$143,375
PL5	$78,067	—	—	$78,067	—	$78,067
PL6	—	$88,891	$34,242	$88,891	—	$123,133
PN1	$249,480	$65,587	—	$315,067	—	$315,067
PN2	$262,071	$49,276	$6,912	$311,347	—	$318,259
PN3	$1,123,665	$53,011	—	$1,176,676	$543,570	$1,720,247
PN4	$920,942	$22,816	—	$943,758	—	$943,758
WD1	$123,313	$14,117	—	$137,430	—	$137,430
WD2	$410,651	$78,273	$43,010	$488,924	—	$531,934
BE1	$862,686	$59,381	—	$922,067	—	$922,067
BE2	$644,433	—	—	$644,433	—	$644,433
BH9	—	$33,491	—	$33,491	—	$33,491
LT1	—	$(17,058)	—	$(17,058)	$905,950	$888,892
Total	$5,622,273	$1,133,515	$84,164	$6,755,788	$1,794,840	$8,634,793

Conclusions

This report documents results of an in-depth analysis of selected process and building systems improvement ideas generated from the Phase 1 assessment. Areas studied included plating, painting, machining, welding, foundry, and heat treatment shops; building envelope, heating, ventilation, air conditioning, lighting; and steam boilers. The major focus was to develop and engineer the process or building systems modifications. The end product from this Level II analysis is a group of "appropriation grade" performance improvement projects for funding and implementation. Twenty-eight Energy Conservation Measures (ECMs) were selected by Arsenal staff for further evaluation at the beginning of the Phase 2 study. These 28 measures are associated with the following production processes and systems:

Processes	Systems
1. Plating	7. Building Envelope
2. Painting	8. Building HVAC
3. Heat Treatment	9. Lighting
4. Machining	10. Boiler Plant
5. Foundry	
6. Welding	

Upon further investigation, several measures were dropped due to various reasons as explained in each ECM write-up. Economical quantification of the evaluated ECMs (Table 31) shows that, when implemented, the 18 ECMs will allow RIA to reduce its annual energy and operating costs by approximately $1.15M. The capital investment required to accomplish these savings is approximately $3.26M, indicating an average simple payback period of 2.84 years (34 months). Production-processes related measures contribute to 80 percent of savings. it also represents 75 percent of the investment. Building systems related measures contribute to 20 percent of the savings while represents 25 percent of the investment. Potential funding sources the Arsenal may pursue are recommended in Table 31 for each ECM. They are based on savings category as identified in the Table.

LCCA results and supporting cost savings calculations are also documented in this report for the 15 ECIP ECMs. This study was developed through an extensive two-year industrial facility audit and engineering assessment that involved installation staff, Corps of Engineers representatives, and private consultants including a number of highly qualified industrial specialists, several ventilation consultants from Europe, and a team from the University of Illinois. This study focused on industrial facility efficiency improvements with emphasis on LEAN and sustainable design principles. There are two principle areas of work including plating shop and paint booth improvements. Other areas of work include ventilation improvements in the weld shop and heat treat shop, building envelope improvements in two buildings, cooling tower modifications for a compressor plant, and installation of T5 task lighting in welding and other shops. The composite cost savings are projected to be $570,030/yr and energy savings are projected to be 78,277MBtu/yr. The project simple payback is 2.65 years, the savings/investment ratio is 10.2 and the adjusted internal rate of return (AIRR) is 16 percent.

Recommendations

The Level II analysis of multiple complex processes and systems conducted during the Phase 2 (see Table 8) resulted in a list of “appropriation grade” process and energy systems improvement projects with an engineering and economical analysis sufficient for consideration of funding and implementation. The quantity and quality of the process improvements identified suggests that significant potential exists (>$1.1M in savings with an average simple pay back period of 2.9 years). It is recommended that RIA accomplish these potential cost saving projects as an integral part of its comprehensive and aggressive program of process optimization linked to the ongoing “LEAN” efforts.

It is also recommended that RIA moves forward with the Phase 3, which includes implementation, performance measurement and verification (M&V) assessment. This effort most likely requires a combination of in-house and outside support.

Phase 3 work will be focused on providing support to project design, construction as well as M&V of project savings. CERL and expert consultants will provide guidance and further assistance in identifying a specific Phase 3 scope of work, respective roles, and the most expeditious implementation path. This will begin with a formal review of this report, combined with a planning session to organize the Phase 3 program.

Acronyms and Abbreviations

Term	**Spellout**
AC	alternating current
AHU	air handling unit
AIRR	Adjusted Internal Rate of Return
AMC	U.S. Army Materiel Command
ANSI	American National Standards Institute
BHP	brake horsepower
BP	Boiler Plant
BRAC	Base Realignment and Closure
BTU	British Thermal Unit
CA	Compressed Air
CARC	Chemical Agent Resistant Coating
CDD	total cooling degree days
CDT	central daylight time
CEERD	U.S. Army Corps of Engineers, Engineer Research and Development Center
CERL	Construction Engineering Research Laboratory
CFR	Code of the Federal Regulations
CO	carbon monoxide
COSHH	Control of Substances Hazardous to Health
CWE	current working estimate
DO	Dissolved Oxygen
DOD	Department of Defense
DPW	Directorate of Public Works
ECIP	Energy Conservation Investment Program
ECM	Environmental Climate Model
EED	Emission Elimination Devices
EIA	Energy Information Administration
EO	Executive Order
EPA	Environmental Protection Agency
ERDC	Engineer Research and Development Center
ES	Electrical System
ESPC	Energy Savings Performance Contract
ESTCP	Environmental Security Technology Certification Program
ETSI	Energy Technology Services International, Inc.
FEMP	Federal Energy Management Program
FY	fiscal year
HDD	heating degree days
HID	high intensity discharge
HP	Horsepower
HQ	Headquarters
HVAC	heating, ventilating, and air conditioning
IAQ	indoor air quality
IJO	individual job order

Term	Spellout
IMA	Installation Management Agency
IR	Infrared
JCI	Johnson Controls, Inc.
KLB	1000 lbs.
kW	Kilowatt
kWh	kilowatt hour
LCC	life cycle cost
LCCA	life-cycle cost analysis
LPG	liquid petroleum gas
MIG	Gas Metal Arc Welding
MILCON	Military Construction
MIPR	Military Interdepartmental Purchase Request
MW	Megawatt
MWH	megawatt hour
NET	New Equipment Training
NIST	National Institute of Standards and Technology
OACSIM	Office of the Assistant Chief of Staff for Installation Management
OCONUS	outside continental United States
OMB	Office of Management and Budget
OSD	Office of the Secretary of Defense
OSHA	Occupational Safety and Health Administration
PEOA	Process Energy Optimization Assessment
PEPR	Process Energy and Pollution Reduction
PET	Post Energy Team
ppm	parts per million
RDF	refuse derived fuel
REARM	Renovation of Armament Manufacturing
RIA	Rock Island Arsenal
RRMC	Rapid Response Manufacturing Cell
SI	Systeme Internationale
SIR	savings to investment ratio
SP	static pressure
SPV	Single Present Value
TAT	turnaround time
TBD	to be determined
TC	Technical Committee
TIG	Gas Tungsten Arc Welding
TR	Technical Report
TRGS	Technische Regeln für Gefahrstoffe [Technical Rules for Dangerous Materials]
UIC	University of Illinois at Chicago
UPV	Uniform Present Value
URL	Universal Resource Locator
USACE	U.S. Army Corps of Engineers
VAV	variable air volume
VEA	Ventilation/Energy Applications

Appendix A: LCCA BLCC5 Input Files

PL#1: Install EED on All Chrome Plating Tanks

NIST BLCC 5.3-05: Input Data Listing

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 Code of the Federal Regulations (CFR), Part 436, Subpart A

General Information

File Name:	C:\Program Files\BLCC5\projects\PL#1.xml
Date of Study:	Mon Aug 08 09:43:59 central daylight time (CDT) 2005
Analysis Type:	MILCON Analysis, ECIP Project
Project Name:	Install EED on 15 chrome plating tanks
Project Location:	Illinois
Analyst:	Underwood
Base Date:	1 October 2005
Beneficial Occupancy Date:	1October 2005
Study Period:	20 yrs 0 months (1 October 2005 through 30 September 2025)
Discount Rate:	3%
Discounting Convention:	Mid-Year
Discount and Escalation Rates are REAL (exclusive of general inflation)	

Savings from Alternative:

Energy Savings/Cost: Scrubber exhaust fan energy

Annual Savings:	1,432,096.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: Scrubber pumps

Annual Savings:	362,556.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: Surface Evaporation Steam Heat

Annual Savings:	1,519.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Energy Savings/Cost: Makeup Air Fan Energy

Annual Savings:	507,578.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: Palm Fan Energy

Annual Savings:	-3,357.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Capital Component Savings/Costs:

Additional Investment Cost

Construction Cost:	$931,700
SIOH:	$53,110
Design Cost:	$0
Total Cost:	$984,810
Salvage Value of Existing Equipment:	$0
Public Utility Company Rebate:	$0
Total Investment:	$984,810

Annually Recurring Savings/Cost: scrubber maintenance Labor & materials

Amount Saved:	$18,000
Annual Rate of Increase:	3%

Usage Indices

From Date	Duration	Factor
1 October 2005	Remaining	100%

Annually Recurring Savings/Cost: scrubber operation labor & material

Amount Saved:	$22,000
Annual Rate of Increase:	3%

Usage Indices

From Date	Duration	Factor
1 October 2005	Remaining	100%

Annually Recurring Savings/Cost: Waste Disposal Monitoring

Amount Saved:	$10,000
Annual Rate of Increase:	3%

Usage Indices

From Date	Duration	Factor
1 October 2005	Remaining	100%

Annually Recurring Savings/Cost: Palm Membrane Filter Replacement

Amount Saved:	-$4,500
Annual Rate of Increase:	3%

Usage Indices

From Date	Duration	Factor
1 October 2005	Remaining	100%

Annually Recurring Savings/Cost: Palm Maintenance Labor

Amount Saved:	-$3,000
Annual Rate of Increase:	3%

Usage Indices

From Date	Duration	Factor
1 October 2005	Remaining	100%

Annually Recurring Savings/Cost: Palm evacuation filter replacement

Amount Saved:	-$3,000
Annual Rate of Increase:	3%

Usage Indices

From Date	Duration	Factor
1 October 2005	Remaining	100%

Non-Annually Recurring Savings/Costs: Scrubber overhaul 5 yrs.

Years/Months:	5 yrs 0 months
Amount Saved:	$600,000
Annual Rate of Increase:	3%

Non-Annually Recurring Savings/Costs: Scrubber overhaul 10 yrs

Years/Months:	10 yrs 0 months
Amount Saved:	$600,000
Annual Rate of Increase:	3%

Non-Annually Recurring Savings/Costs: Scrubber overhaul 15 yrs

Years/Months:	15 yrs 0 months
Amount Saved:	$600,000
Annual Rate of Increase:	3%

PL#1A: Install EED on two chrome plating tanks

NIST BLCC 5.3-05: Input Data Listing

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

General Information

File Name:	C:\Program Files\BLCC5\projects\PL1A.xml
Date of Study:	Wed Aug 03 15:14:03 CDT 2005
Analysis Type:	MILCON Analysis, ECIP Project
Project Name:	Install EED on 2 chrome plating tanks
Project Location:	Illinois
Analyst:	Underwood
Base Date:	1 October 2005
Beneficial Occupancy Date:	1 October 2005

Study Period:	20 yrs 0 months (1 October 2005 through 30 September 2025)
Discount Rate:	3%
Discounting Convention:	Mid-Year
Discount and Escalation Rates are REAL (exclusive of general inflation)	

Savings from Alternative:

Energy Savings/Cost: Scrubber exhaust fan energy

Annual Savings:	190,946.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%

From Date	Duration	Escalation
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: Scrubber pumps

Annual Savings:	48,341.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%

From Date	Duration	Escalation
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: Surface Evaporation Steam Heat

Annual Savings:	203.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%

From Date	Duration	Escalation
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Energy Savings/Cost: Makeup air heat

Annual Savings:	1,462.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%

From Date	Duration	Escalation
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Energy Savings/Cost: Makeup Air Fan Energy

Annual Savings:	67,677.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%

From Date	Duration	Escalation
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: Palm Fan Energy

Annual Savings:	-448.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%

From Date	Duration	Escalation
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Capital Component Savings/Costs:

Additional Investment Cost

Construction Cost:	$145,200
SIOH:	$8,280
Design Cost:	$0
Total Cost:	$153,480
Salvage Value of Existing Equipment:	$0
Public Utility Company Rebate:	$0
Total Investment:	$153,480

Annually Recurring Savings/Cost: Scrubber Maintenance Labor & Materials

Amount Saved:	$2,400
Annual Rate of Increase:	3%

Usage Indices

From Date	Duration	Factor
1 October 2005	Remaining	100%

Annually Recurring Savings/Cost: scrubber operation labor & material

Amount Saved:	$2,933
Annual Rate of Increase:	3%

Usage Indices

From Date	Duration	Factor
1 October 2005	Remaining	100%

Annually Recurring Savings/Cost: waste disposal monitoring

Amount Saved:	$1,333
Annual Rate of Increase:	3%

Usage Indices

From Date	Duration	Factor
1 October 2005	Remaining	100%

Annually Recurring Savings/Cost: Palm Membrane Filter Replacement

Amount Saved:	-$600
Annual Rate of Increase:	3%

Usage Indices

From Date	Duration	Factor
1 October 2005	Remaining	100%

Annually Recurring Savings/Cost: Palm Maintenance Labor

Amount Saved:	-$400
Annual Rate of Increase:	3%

Usage Indices

From Date	Duration	Factor
1 October 2005	Remaining	100%

Annually Recurring Savings/Cost: Palm Evacuation Filter Replacement

Amount Saved:	-$400
Annual Rate of Increase:	3%

Usage Indices

From Date	Duration	Factor
1 October 2005	Remaining	100%

Non-Annually Recurring Savings/Costs: Scrubber overhaul 5 yrs.

Years/Months:	5 yrs 0 months
Amount Saved:	$80,000
Annual Rate of Increase:	3%

Non-Annually Recurring Savings/Costs: Scrubber overhaul 10 yrs

Years/Months:	10 yrs 0 months
Amount Saved:	$80,000
Annual Rate of Increase:	3%

Non-Annually Recurring Savings/Costs: Scrubber overhaul 15 yrs

Years/Months:	15 yrs 0 months
Amount Saved:	$80,000
Annual Rate of Increase:	3%

PL#2: Control Air Flows and Steam Heating

NIST BLCC 5.3-05: Input Data Listing

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

General Information

File Name:	C:\Program Files\BLCC5\projects\PL2.xml
Date of Study:	Wed Aug 03 14:31:40 CDT 2005
Analysis Type:	MILCON Analysis, ECIP Project
Project Name:	Control Air Flows and Steam Heating
Project Location:	Illinois
Analyst:	Underwood
Base Date:	1 October 2005
Beneficial Occupancy Date:	1 October 2005
Study Period:	20 yrs 0 months (1 October 2005 through 30 September 2025)
Discount Rate:	3%
Discounting Convention:	Mid-Year
Discount and Escalation Rates are REAL (exclusive of general inflation)	

Savings from Alternative:

Energy Savings/Cost: scrubber exhaust fan energy

Annual Savings:	751,520.0 kWh

Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: Other Exhaust Fans

Annual Savings:	335,800.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%

From Date	Duration	Escalation
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: MAU fan energy

Annual Savings:	613,200.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%

From Date	Duration	Escalation
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: makeup air heat

Annual Savings:	7,908.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%

From Date	Duration	Escalation
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Capital Component Savings/Costs:

Additional Investment Cost

Construction Cost:	$200,530
SIOH:	$11,430
Design Cost:	$0
Total Cost:	$211,960
Salvage Value of Existing Equipment:	$0
Public Utility Company Rebate:	$0
Total Investment:	$211,960

PL#3: Insulating Hot Plating Tanks and Rinse Tanks

NIST BLCC 5.3-05: Input Data Listing

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

General Information

File Name:	C:\Program Files\BLCC5\projects\PL3.xml
Date of Study:	Mon Aug 01 13:27:36 CDT 2005
Analysis Type:	MILCON Analysis, ECIP Project
Project Name:	Insulate hot plating tanks & rinse tanks
Project Location:	Illinois
Analyst:	Underwood
Base Date:	1 October 2005
Beneficial Occupancy Date:	1 October 2005
Study Period:	20 yrs 0 months (1 October 2005 through 30 September 2025)
Discount Rate:	3%

Discounting Convention:	Mid-Year
Discount and Escalation Rates are REAL (exclusive of general inflation)	

Savings from Alternative

Energy Savings/Cost: steam heat

Annual Savings:	1,708.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%

From Date	Duration	Escalation
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: Scrubber pumps

Annual Savings:	48,341.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%

From Date	Duration	Escalation
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: Surface evaporation steam heat

Annual Savings:	203.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%

From Date	Duration	Escalation
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Energy Savings/Cost: Makeup air heat

Annual Savings:	1,462.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%

From Date	Duration	Escalation
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Energy Savings/Cost: Makeup air fan energy

Annual Savings:	67,677.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%

From Date	Duration	Escalation
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: Palm Fan Energy

Annual Savings:	-448.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%

From Date	Duration	Escalation
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Capital Component Savings/Costs:

Additional Investment Cost

Construction Cost:	$145,200
SIOH:	$8,280
Design Cost:	$0
Total Cost:	$153,480
Salvage Value of Existing Equipment:	$0
Public Utility Company Rebate:	$0
Total Investment:	$153,480

Annually Recurring Savings/Cost: scrubber maintenance Labor & materials

Amount Saved:	$2,400
Annual Rate of Increase:	3%

Usage Indices

From Date	Duration	Factor
1 October 2005	Remaining	100%

Annually Recurring Savings/Cost: scrubber operation labor & material

Amount Saved:	$2,933
Annual Rate of Increase:	3%

Usage Indices

From Date	Duration	Factor
1 October 2005	Remaining	100%

Annually Recurring Savings/Cost: waste disposal monitoring

Amount Saved:	$1,333
Annual Rate of Increase:	3%

Usage Indices

From Date	Duration	Factor
1 October 2005	Remaining	100%

Annually Recurring Savings/Cost: Palm membrane filter replacement

Amount Saved:	-$600
Annual Rate of Increase:	3%

Usage Indices

From Date	Duration	Factor
1 October 2005	Remaining	100%

Annually Recurring Savings/Cost: Palm Maintenance Labor

Amount Saved:	-$400
Annual Rate of Increase:	3%

Usage Indices

From Date	Duration	Factor
1 October 2005	Remaining	100%

Annually Recurring Savings/Cost: Palm evacuation filter replacement

Amount Saved:	-$400
Annual Rate of Increase:	3%

Usage Indices

From Date	Duration	Factor
1 October 2005	Remaining	100%

Non-Annually Recurring Savings/Costs: Scrubber overhaul 5 yrs.

Years/Months:	5 yrs 0 months
Amount Saved:	$80,000
Annual Rate of Increase:	3%

Non-Annually Recurring Savings/Costs: Scrubber overhaul 10 yrs

Years/Months:	10 yrs 0 months
Amount Saved:	$80,000
Annual Rate of Increase:	3%

Non-Annually Recurring Savings/Costs: Scrubber overhaul 15 yrs

Years/Months:	15 yrs 0 months
Amount Saved:	$80,000
Annual Rate of Increase:	3%

PL#2: Control Air Flows and Steam Heating

NIST BLCC 5.3-05: Input Data Listing

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

General Information

File Name:	C:\Program Files\BLCC5\projects\PL2.xml
Date of Study:	Wed Aug 03 14:31:40 CDT 2005
Analysis Type:	MILCON Analysis, ECIP Project
Project Name:	Control Air Flows and Steam Heating
Project Location:	Illinois
Analyst:	Underwood
Base Date:	1 October 2005
Beneficial Occupancy Date:	1 October 2005
Study Period:	20 yrs 0 months (1 October 2005 through 30 September 2025)
Discount Rate:	3%
Discounting Convention:	Mid-Year
Discount and Escalation Rates are REAL (exclusive of general inflation)	

Savings from Alternative:

Energy Savings/Cost: scrubber exhaust fan energy

Annual Savings:	751,520.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: Other Exhaust Fans

Annual Savings:	335,800.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: MAU fan energy

Annual Savings:	613,200.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: makeup air heat

Annual Savings:	7,908.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Capital Component Savings/Costs:

Additional Investment Cost

Construction Cost:	$200,530
SIOH:	$11,430
Design Cost:	$0

Total Cost:	$211,960
Salvage Value of Existing Equipment:	$0
Public Utility Company Rebate:	$0
Total Investment:	$211,960

PL#3: Insulating Hot Plating Tanks and Rinse Tanks

NIST BLCC 5.3-05: Input Data Listing

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

General Information

File Name:	C:\Program Files\BLCC5\projects\PL3.xml
Date of Study:	Mon Aug 01 13:27:36 CDT 2005
Analysis Type:	MILCON Analysis, ECIP Project
Project Name:	Insulate hot plating tanks & rinse tanks
Project Location:	Illinois
Analyst:	Underwood
Base Date:	1 October 2005
Beneficial Occupancy Date:	1 October 2005
Study Period:	20 yrs 0 months (1 October 2005 through 30 September 2025)
Discount Rate:	3%
Discounting Convention:	Mid-Year
Discounting Convention:	Mid-Year
Discount and Escalation Rates are REAL (exclusive of general inflation)	

Savings from Alternative

Energy Savings/Cost: steam heat

Annual Savings:	1,708.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Capital Component Savings/Costs:

Additional Investment Cost

Construction Cost:	$95,515
SIOH:	$5,444
Design Cost:	$0
Total Cost:	$100,959
Salvage Value of Existing Equipment:	$0
Public Utility Company Rebate:	$0
Total Investment:	$100,959

PL#5: Allow Hot Plating and Rinse Tanks to Cool Down

NIST BLCC 5.3-05: Input Data Listing

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

General Information

File Name:	C:\Program Files\BLCC5\projects\PL5.xml
Date of Study:	Wed Aug 03 15:39:16 CDT 2005
Analysis Type:	MILCON Analysis, ECIP Project
Project Name:	Insulate hot plating tanks & rinse tanks
Project Location:	Illinois
Analyst:	Underwood
Base Date:	1 October 2005
Beneficial Occupancy Date:	1 October 2005
Study Period:	20 yrs 0 months (1 October 2005 through 30 September 2025)
Discount Rate:	3%
Discounting Convention:	Mid-Year
Discount and Escalation Rates are REAL (exclusive of general inflation)	

Savings from Alternative:

Energy Savings/Cost: steam heat

Annual Savings:	930.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%

From Date	Duration	Escalation
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Capital Component Savings/Costs

Additional Investment Cost

Construction Cost:	$2,376
SIOH:	$135
Design Cost:	$0
Total Cost:	$2,511
Salvage Value of Existing Equipment:	$0
Public Utility Company Rebate:	$0
Total Investment:	$2,511

PL# 6: Retrofit MAUs with Low Pressure Drop Filters

NIST BLCC 5.3-05: Input Data Listing

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

General Information

File Name:	C:\Program Files\BLCC5\projects\PL6.xml
Date of Study:	Wed Aug 03 15:45:34 CDT 2005
Analysis Type:	MILCON Analysis, ECIP Project
Project Name:	Retrofit MAUs with Low P Filters
Project Location:	Illinois
Analyst:	Underwood
Base Date:	1 October 2005
Beneficial Occupancy Date:	1 October 2005
Study Period:	20 yrs 0 months (1 October 2005 through 30 September 2025)
Discount Rate:	3%
Discounting Convention:	Mid-Year
Discount and Escalation Rates are REAL (exclusive of general inflation)	

Savings from Alternative

Energy Savings/Cost: Electricity

Annual Savings:	260,172.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$2,269
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%

From Date	Duration	Escalation
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Capital Component Savings/Costs:

Additional Investment Cost

Construction Cost:	$73,260
SIOH:	$4,176
Design Cost:	$0
Total Cost:	$77,436
Salvage Value of Existing Equipment:	$0
Public Utility Company Rebate:	$0
Total Investment:	$77,436

PN#1: Enclose Drive-Thru Paint Booth #1 in Building 208

NIST BLCC 5.3-05: Input Data Listing

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

General Information

File Name:	C:\Program Files\BLCC5\projects\PN1.xml
Date of Study:	Mon Aug 01 13:46:48 CDT 2005
Analysis Type:	MILCON Analysis, ECIP Project
Project Name:	Enclose paint booth#1 in B208
Project Location:	Illinois
Analyst:	Underwood
Base Date:	1 October 2005
Beneficial Occupancy Date:	1 October 2005
Study Period:	20 yrs 0 months (1 October 2005 through 30 September 2025)
Discount Rate:	3%
Discounting Convention:	Mid-Year
Discount and Escalation Rates are REAL (exclusive of general inflation)	

Savings from Alternative

Energy Savings/Cost: Fan Energy

Annual Savings:	191,964.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%

From Date	Duration	Escalation
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: Steam Heat

Annual Savings:	2,972.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Capital Component Savings/Costs:

Additional Investment Cost

Construction Cost:	$75,460
SIOH:	$4,300
Design Cost:	$0
Total Cost:	$79,760
Salvage Value of Existing Equipment:	$0
Public Utility Company Rebate:	$0
Total Investment:	$79,760

PN#2: Enclose Drive-Thru Paint Booth # 2 in Building 208

NIST BLCC 5.3-05: Input Data Listing

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

General Information

File Name:	C:\Program Files\BLCC5\projects\PN2.xml
Date of Study:	Mon Aug 01 13:58:35 CDT 2005
Analysis Type:	MILCON Analysis, ECIP Project
Project Name:	Enclose paint booth2 in B208
Project Location:	Illinois
Analyst:	Underwood
Base Date:	1 October 2005
Beneficial Occupancy Date:	1 October 2005
Study Period:	20 yrs 0 months (1 October 2005 through 30 September 2025)
Discount Rate:	3%
Discounting Convention:	Mid-Year
Discount and Escalation Rates are REAL (exclusive of general inflation)	

Savings from Alternative

Energy Savings/Cost: Fan Energy

Annual Savings:	144,225.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$458
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%

From Date	Duration	Escalation
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: Exhaust air flow reduction

Annual Savings:	3,122.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Capital Component Savings/Costs:

Additional Investment Cost

Construction Cost:	$125,290
SIOH:	$7,140
Design Cost:	$0
Total Cost:	$132,430
Salvage Value of Existing Equipment:	$0
Public Utility Company Rebate:	$0
Total Investment:	$132,430

PN#3: Paint Booth #4 Improvements in Building 299NIST BLCC 5.3-05: Input Data Listing

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

General Information

File Name:	C:\Program Files\BLCC5\projects\PN3.xml
Date of Study:	Mon Aug 01 14:10:25 CDT 2005
Analysis Type:	MILCON Analysis, ECIP Project
Project Name:	Paint booth 4 improvement in B299
Project Location:	Illinois
Analyst:	Underwood
Base Date:	1 October 2005
Beneficial Occupancy Date:	1 October 2005
Study Period:	20 yrs 0 months (1 October 2005 through 30 September 2025)
Discount Rate:	3%
Discounting Convention:	Mid-Year
Discount and Escalation Rates are REAL (exclusive of general inflation)	

Savings from Alternative:

Energy Savings/Cost: Fan energy

Annual Savings:	79,471.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%

From Date	Duration	Escalation
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: heating

Annual Savings:	5,679.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%

From Date	Duration	Escalation
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Energy Savings/Cost: Oven#4

Annual Savings:	75,686.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: Booth 4 and Oven 4 Heating

Annual Savings:	7,707.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Capital Component Savings/Costs:

Additional Investment Cost

Construction Cost:	$137,995
SIOH:	$7,865
Design Cost:	$0
Total Cost:	$145,860
Salvage Value of Existing Equipment:	$0
Public Utility Company Rebate:	$0
Total Investment:	$145,860

Annually Recurring Savings/Cost: TAT Employee Labor

Amount Saved:	$36,000
Annual Rate of Increase:	0%

Usage Indices

From Date	Duration	Factor
1 October 2005	Remaining	100%

PN#4: Paint Booth #5 Improvements in Building 299

NIST BLCC 5.3-05: Input Data Listing

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

General Information

File Name:	C:\Program Files\BLCC5\projects\PN4.xml
Date of Study:	Wed Aug 03 16:13:53 CDT 2005
Analysis Type:	MILCON Analysis, ECIP Project
Project Name:	Paint booth 5 improvement in B299
Project Location:	Illinois
Analyst:	Underwood
Base Date:	1 October 2005
Beneficial Occupancy Date:	1 October 2005
Beneficial Occupancy Date:	1 October 2005
Study Period:	20 yrs 0 months (1 October 2005 through 30 September 2025)
Discount Rate:	3%
Discounting Convention:	Mid-Year
Discount and Escalation Rates are REAL (exclusive of general inflation)	

Savings from Alternative:

Energy Savings/Cost: fan energy

Annual Savings:	66,778.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%

From Date	Duration	Escalation
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: Heating

Annual Savings:	1,569.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0

End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%

From Date	Duration	Escalation
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Energy Savings/Cost: Oven 4 heating

Annual Savings:	9,402.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%

From Date	Duration	Escalation
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Capital Component Savings/Costs:

Additional Investment Cost

Construction Cost:	$46,970
SIOH:	$2,680
Design Cost:	$0
Total Cost:	$49,650
Salvage Value of Existing Equipment:	$0
Public Utility Company Rebate:	$0
Total Investment:	$49,650

WD#1: Install Ergonomic Extraction Arms in Welding Shop

NIST BLCC 5.3-05: Input Data Listing

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

General Information

File Name:	C:\Program Files\BLCC5\projects\WD1.xml
Date of Study:	Wed Aug 03 16:38:39 CDT 2005
Analysis Type:	MILCON Analysis, ECIP Project
Project Name:	Install ergonomic extraction arms
Project Location:	Illinois
Analyst:	Underwood

Base Date:	1 October 2005
Beneficial Occupancy Date:	1 October 2005
Study Period:	20 yrs 0 months (1 October 2005 through 30 September 2025)
Discount Rate:	3%
Discounting Convention:	Mid-Year
Discount and Escalation Rates are REAL (exclusive of general inflation)	

Discount and Escalation Rates are REAL (exclusive of general inflation)	

Savings from Alternative:

Energy Savings/Cost: exhaust fan energy

Annual Savings:	17,990.0 kWh
Price per Unit:	$0.02600
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%

From Date	Duration	Escalation
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: Supply Fan Energy

Annual Savings:	17,990.0 kWh
Price per Unit:	$0.02600
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%

From Date	Duration	Escalation
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: makeup air heat

Annual Savings:	1,469.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%

From Date	Duration	Escalation
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Capital Component Savings/Costs:

Additional Investment Cost

Construction Cost:	$115,000
SIOH:	$6,555
Design Cost:	$0
Total Cost:	$121,555
Salvage Value of Existing Equipment:	$0
Public Utility Company Rebate:	$0
Total Investment:	$121,555

WD#2: Install Improved Ventilations System in Welding Shop

NIST BLCC 5.3-05: Input Data Listing

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

General Information

File Name:	C:\Program Files\BLCC5\projects\WD2.xml
Date of Study:	Wed Aug 03 16:49:26 CDT 2005
Analysis Type:	MILCON Analysis, ECIP Project
Project Name:	Install improved ventilation system
Project Location:	Illinois
Analyst:	Underwood
Base Date:	1 October 2005
Beneficial Occupancy Date:	1 October 2005
Study Period:	20 yrs 0 months (1 October 2005 through 30 September 2025)
Discount Rate:	3%
Discounting Convention:	Mid-Year
Discount and Escalation Rates are REAL (exclusive of general inflation)	

Savings from Alternative:

Energy Savings/Cost: exhaust fan energy

Annual Savings:	174,564.0 kWh
Price per Unit:	$0.02402
Demand Charge:	$2,850
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: HUV Fan Energy

Annual Savings:	53,712.0 kWh
Price per Unit:	$0.01850
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: Steam heat

Annual Savings:	4,892.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Capital Component Savings/Costs:

Additional Investment Cost

Construction Cost:	$15,000
SIOH:	$855
Design Cost:	$0
Total Cost:	$15,855
Salvage Value of Existing Equipment:	$0
Public Utility Company Rebate:	$0
Total Investment:	$15,855

BE#1: Improve Working Condition and IAQ in Building 220

NIST BLCC 5.3-05: Input Data Listing

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

General Information

File Name:	C:\Program Files\BLCC5\projects\BE1.xml
Date of Study:	Wed Aug 03 17:02:28 CDT 2005
Analysis Type:	MILCON Analysis, ECIP Project
Project Name:	Improving B220 working condition & IAQ
Project Location:	Illinois
Analyst:	Underwood
Base Date:	1 October 2005
Beneficial Occupancy Date:	1 October 2005
Study Period:	20 yrs 0 months (1 October 2005 through 30 September 2025)
Discount Rate:	3%
Discounting Convention:	Mid-Year
Discount and Escalation Rates are REAL (exclusive of general inflation)	

Savings from Alternative:

Energy Savings/Cost: HVU 220RF6 fan energy

Annual Savings:	43,800.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: Unoccupied floor ventilation fan energy

Annual Savings:	130,000.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Energy Savings/Cost: North wall infiltration

Annual Savings:	4,063.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Energy Savings/Cost: Heater control

Annual Savings:	4,063.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Energy Savings/Cost: HVU on return air

Annual Savings:	1,160.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Energy Savings/Cost: HVU220 RE6 steam

Annual Savings:	138.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Energy Savings/Cost: Unoccupied floor ventilation steam

Annual Savings:	853.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%
1 April 2027	1 year 0 months	0%
1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Capital Component Savings/Costs:

Additional Investment Cost

Construction Cost:	$258,500
SIOH:	$14,735
Design Cost:	$0
Total Cost:	$273,235
Salvage Value of Existing Equipment:	$0
Public Utility Company Rebate:	$0
Total Investment:	$273,235

BE#2: Install High Speed Doors Where Necessary

NIST BLCC 5.3-05: Input Data Listing

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

General Information

File Name:	C:\Program Files\BLCC5\projects\BE2.xml
Date of Study:	Wed Aug 03 17:10:06 CDT 2005
Analysis Type:	MILCON Analysis, ECIP Project
Project Name:	Install high speed door
Project Location:	Illinois
Analyst:	Underwood
Base Date:	1 October 2005
Beneficial Occupancy Date:	1 October 2005
Study Period:	20 yrs 0 months (1 October 2005 through 30 September 2025)
Discount Rate:	3%
Discounting Convention:	Mid-Year
Discount and Escalation Rates are REAL (exclusive of general inflation)	

Savings from Alternative:

Energy Savings/Cost: steam heat

Annual Savings:	7,677.0 MBtu
Price per Unit:	$5.61500
Demand Charge:	$0
Utility Rebate:	$0
End-Use:	Pulverized coal fired, Dry bottom
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	0.7%
1 April 2006	1 year 0 months	-1.39%
1 April 2007	1 year 0 months	0%
1 April 2008	1 year 0 months	-0.7%
1 April 2009	1 year 0 months	0%
1 April 2010	1 year 0 months	0.71%
1 April 2011	1 year 0 months	-0.7%
1 April 2012	1 year 0 months	0%
1 April 2013	1 year 0 months	-0.71%
1 April 2014	1 year 0 months	0.71%
1 April 2015	1 year 0 months	0%
1 April 2016	1 year 0 months	0%
1 April 2017	1 year 0 months	0.71%
1 April 2018	1 year 0 months	0%
1 April 2019	1 year 0 months	0%
1 April 2020	1 year 0 months	0.7%
1 April 2021	1 year 0 months	0%
1 April 2022	1 year 0 months	0.7%
1 April 2023	1 year 0 months	0.69%
1 April 2024	1 year 0 months	0.69%
1 April 2025	1 year 0 months	0%
1 April 2026	1 year 0 months	0.68%
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1 April 2028	1 year 0 months	0%
1 April 2029	1 year 0 months	0.68%
1 April 2030	1 year 0 months	0%
1 April 2031	1 year 0 months	0.68%
1 April 2032	1 year 0 months	0%
1 April 2033	1 year 0 months	0%
1 April 2034	1 year 0 months	0.67%
1 April 2035	Remaining	0.27%

Capital Component Savings/Costs:

Additional Investment Cost

Construction Cost:	$60,500
SIOH:	$3,450
Design Cost:	$0
Total Cost:	$63,950
Salvage Value of Existing Equipment:	$0
Public Utility Company Rebate:	$0
Total Investment:	$63,950

BH#9: Perform Further Energy Savings Measures in Building 222

NIST BLCC 5.3-05: Input Data Listing

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

General Information

File Name:	C:\Program Files\BLCC5\projects\BH9.xml
Date of Study:	Wed Aug 03 17:05:31 CDT 2005
Analysis Type:	MILCON Analysis, ECIP Project
Project Name:	Perform further energy saving in B222
Project Location:	Illinois
Analyst:	Underwood
Base Date:	1 October 2005
Beneficial Occupancy Date:	1 October 2005
Study Period:	20 yrs 0 months (1 October 2005 through 30 September 2025)
Discount Rate:	3%
Discounting Convention:	Mid-Year
Discount and Escalation Rates are REAL (exclusive of general inflation)	

Savings from Alternative:

Energy Savings/Cost: Cooling tower pump

Annual Savings:	98,024.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%
1 April 2033	1 year 0 months	0.45%
1 April 2034	1 year 0 months	0.45%
1 April 2035	Remaining	0.44%

Capital Component Savings/Costs:

Additional Investment Cost

Construction Cost:	$2,500
SIOH:	$142
Design Cost:	$0
Total Cost:	$2,642
Salvage Value of Existing Equipment:	$0
Public Utility Company Rebate:	$0
Total Investment:	$2,642

LT#1: Install Task Lamps in Areas Require Additional Lighting

NIST BLCC 5.3-05: Input Data Listing

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

General Information

File Name:	C:\Program Files\BLCC5\projects\LT1.xml
Date of Study:	Wed Aug 03 17:07:11 CDT 2005
Analysis Type:	MILCON Analysis, ECIP Project
Project Name:	Install task lamps in areas req. add. lighting
Project Location:	Illinois
Analyst:	Underwood
Base Date:	1 October 2005
Beneficial Occupancy Date:	1 October 2005
Study Period:	20 yrs 0 months (1 October 2005 through 30 September 2025)
Discount Rate:	3%
Discounting Convention:	Mid-Year
Discount and Escalation Rates are REAL (exclusive of general inflation)	

Savings from Alternative:

Energy Savings/Cost: Electricity

Annual Savings:	-49,927.0 kWh
Price per Unit:	$0.02264
Demand Charge:	$0
Utility Rebate:	$0
Location:	U.S. Average
Rate Schedule:	Industrial
State:	Illinois

Usage Indices

From Date	Duration	Usage Index
1 October 2005	Remaining	100%

Escalation Rates

From Date	Duration	Escalation
1 April 2005	1 year 0 months	-2.52%
1 April 2006	1 year 0 months	-3.55%
1 April 2007	1 year 0 months	-1.91%
1 April 2008	1 year 0 months	-0.39%
1 April 2009	1 year 0 months	-0.47%
1 April 2010	1 year 0 months	-0.87%
1 April 2011	1 year 0 months	0.87%
1 April 2012	1 year 0 months	2.36%
1 April 2013	1 year 0 months	3.08%
1 April 2014	1 year 0 months	2.16%
1 April 2015	1 year 0 months	1.24%
1 April 2016	1 year 0 months	1.52%
1 April 2017	1 year 0 months	1.71%
1 April 2018	1 year 0 months	1.96%
1 April 2019	1 year 0 months	1.17%
1 April 2020	1 year 0 months	1.08%
1 April 2021	1 year 0 months	0.27%
1 April 2022	1 year 0 months	0.27%
1 April 2023	1 year 0 months	0.27%
1 April 2024	1 year 0 months	0.53%
1 April 2025	1 year 0 months	0.4%
1 April 2026	1 year 0 months	0.46%
1 April 2027	1 year 0 months	0.46%
1 April 2028	1 year 0 months	0.46%
1 April 2029	1 year 0 months	0.45%
1 April 2030	1 year 0 months	0.45%
1 April 2031	1 year 0 months	0.39%
1 April 2032	1 year 0 months	0.45%

Appendix B: LCCA BLCC5 ECIP Output Files

PL1: NIST BLCC 5.3-05: ECIP Report

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

The LCC calculations are based on the FEMP discount rates and energy price escalation rates updated on 1 April 2005.

Location:	Illinois	Discount Rate:	3%
Project Title:	Install EED on 15 chrome plating tanks	Analyst:	Underwood
Base Date:	1 October 2005	Preparation Date:	Mon Aug 08 09:45:22 CDT 2005
BOD:	1 October 2005	Economic Life:	20 yrs 0 months
File Name:	C:\Program Files\BLCC5\projects\PL#1.xml		

1. Investment

Construction Cost	$931,700
SIOH	$53,110
Design Cost	$0
Total Cost	$984,810
Salvage Value of Existing Equipment	$0
Public Utility Company	$0
Total Investment	$984,810

2. Energy and Water Savings (+) or Cost (-)

Base Date Savings, unit costs, & discounted savings

Item	Unit Cost	Usage Savings	Annual Savings	Discount Factor	Discounted Savings
Electricity	$6.63513	7,844.1 MBtu	$52,046	15.091	$785,440
Coal	$5.61500	12,487.0 MBtu	$70,115	14.950	$1,048,200
Energy Subtotal		20,331.1 MBtu	$122,161		$1,833,640
Water Subtotal		0.0 Mgal	$0		$0
Total			$122,161		$1,833,640

3. Non-Energy Savings (+) or Cost (-)

Item	Savings/Cost	Occurrence	Discount Factor	Discounted Savings/Cost
Annually Recurring	$39,500	Annual	20.000	$790,000
Non-Annually Recurring				
Scrubber overhaul 5 yrs.	$600,000	5 yrs 0 months	0.863	$517,565
Scrubber overhaul 10 yrs	$600,000	10 yrs 0 months	0.744	$446,456
Scrubber overhaul 15 yrs	$600,000	15 yrs 0 months	0.642	$385,117
Non-Annually Recurring Subtotal	$1,800,000			$1,800,000
Total	$1,839,500			$2,590,000

4. First year savings	$251,673	
5. Simple Payback Period (in years)	3.91	(total investment/first-year savings)
6. Total Discounted Operational Savings	$4,423,640	
7. Savings to Investment Ratio (SIR)	4.49	(total discounted operational savings/total investment)
8. Adjusted Internal Rate of Return (AIRR)	11.04%	(1+d)*SIR^(1/n)-1; d=discount rate, n=years in study period

PL1A: NIST BLCC 5.3-05: ECIP Report

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

The LCC calculations are based on the FEMP discount rates and energy price escalation rates updated on 1 April 2005.

Location:	Illinois	Discount Rate:	3%
Project Title:	Install EED on 2 chrome plating tanks	Analyst:	Underwood
Base Date:	1 October 2005	Preparation Date:	Wed Aug 03 15:14:42 CDT 2005
BOD:	1 October 2005	Economic Life:	20 yrs 0 months
File Name:	C:\Program Files\BLCC5\projects\PL1A.xml		

1. Investment

Construction Cost	$145,200
SIOH	$8,280
Design Cost	$0
Total Cost	$153,480
Salvage Value of Existing Equipment	$0
Public Utility Company	$0
Total Investment	$153,480

2. Energy and Water Savings (+) or Cost (-)

Base Date Savings, unit costs, & discounted savings

Item	Unit Cost	Usage Savings	Annual Savings	Discount Factor	Discounted Savings
Electricity	$6.63513	1,045.9 MBtu	$6,940	15.091	$104,725
Coal	$5.61500	1,665.0 MBtu	$9,349	14.950	$139,766
Energy Subtotal		2,710.9 MBtu	$16,288		$244,491
Water Subtotal		0.0 Mgal	$0		$0
Total			$16,288		$244,491

3. Non-Energy Savings (+) or Cost (-)

Item	Savings/Cost	Occurrence	Discount Factor	Discounted Savings/Cost
Annually Recurring	$5,266	Annual	20.000	$105,320
Non-Annually Recurring				
Scrubber overhaul 5 yrs.	$80,000	5 yrs 0 months	0.863	$69,009
Scrubber overhaul 10 yrs	$80,000	10 yrs 0 months	0.744	$59,528
Scrubber overhaul 15 yrs	$80,000	15 yrs 0 months	0.642	$51,349
Non-Annually Recurring Subtotal	$240,000			$240,000
Total	$245,266			$345,320

4. First year savings	$33,556	
5. Simple Payback Period (in years)	4.57	(total investment/first-year savings)
6. Total Discounted Operational Savings	$589,811	
7. Savings to Investment Ratio (SIR)	3.84	(total discounted operational savings/total investment)
8. Adjusted Internal Rate of Return (AIRR)	10.17%	(1+d)*SIR^(1/n)-1; d=discount rate, n=years in study period

PL2: NIST BLCC 5.3-05: ECIP Report

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

The LCC calculations are based on the FEMP discount rates and energy price escalation rates updated on 1 April 2005.

Location:	Illinois	Discount Rate:	3%
Project Title:	Control Air Flows and Steam Heating	Analyst:	Underwood
Base Date:	1 October 2005	Preparation Date:	Wed Aug 03 14:32:28 CDT 2005
BOD:	1 October 2005	Economic Life:	20 yrs 0 months
File Name:	C:\Program Files\BLCC5\projects\PL2.xml		

1. Investment

Construction Cost	$200,530
SIOH	$11,430
Design Cost	$0
Total Cost	$211,960
Salvage Value of Existing Equipment	$0
Public Utility Company	$0
Total Investment	$211,960

2. Energy and Water Savings (+) or Cost (-)

Base Date Savings, unit costs, & discounted savings

Item	Unit Cost	Usage Savings	Annual Savings	Discount Factor	Discounted Savings
Electricity	$6.63513	5,802.4 MBtu	$38,500	15.091	$581,005
Coal	$5.61500	7,908.0 MBtu	$44,403	14.950	$663,824
Energy Subtotal		13,710.4 MBtu	$82,903		$1,244,829
Water Subtotal		0.0 Mgal	$0		$0
Total			$82,903		$1,244,829

3. Non-Energy Savings (+) or Cost (-)

Item	Savings/Cost	Occurrence	Discount Factor	Discounted Savings/Cost
Non-Annually Recurring				
Non-Annually Recurring Subtotal	$0			$0
Total	$0			$0

4. First year savings	$82,903	
5. Simple Payback Period (in years)	2.56	(total investment/first-year savings)
6. Total Discounted Operational Savings	$1,244,829	
7. Savings to Investment Ratio (SIR)	5.87	(total discounted operational savings/total investment)
8. Adjusted Internal Rate of Return (AIRR)	12.53%	(1+d)*SIR^(1/n)-1; d=discount rate, n=years in study period

PL3: NIST BLCC 5.3-05: ECIP Report

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

The LCC calculations are based on the FEMP discount rates and energy price escalation rates updated on 1 April 2005.

Location:	Illinois	Discount Rate:	3%
Project Title:	Insulate hot plating tanks & rinse tanks	Analyst:	Underwood
Base Date:	1 October 2005	Preparation Date:	Wed Aug 03 15:34:40 CDT 2005
BOD:	1 October 2005	Economic Life:	20 yrs 0 months
File Name:	C:\Program Files\BLCC5\projects\PL3.xml		

1. Investment

Construction Cost	$95,515
SIOH	$5,444
Design Cost	$0
Total Cost	$100,959
Salvage Value of Existing Equipment	$0
Public Utility Company	$0
Total Investment	$100,959

2. Energy and Water Savings (+) or Cost (-)

Base Date Savings, unit costs, & discounted savings

Item	Unit Cost	Usage Savings	Annual Savings	Discount Factor	Discounted Savings
Coal	$5.61500	1,708.0 MBtu	$9,590	14.950	$143,375
Energy Subtotal		1,708.0 MBtu	$9,590		$143,375
Water Subtotal		0.0 Mgal	$0		$0
Total			$9,590		$143,375

3. Non-Energy Savings (+) or Cost (-)

Item	Savings/Cost	Occurrence	Discount Factor	Discounted Savings/Cost
Non-Annually Recurring				
Non-Annually Recurring Subtotal	$0			$0
Total	$0			$0

4. First year savings	$9,590	
5. Simple Payback Period (in years)	10.53	(total investment/first-year savings)
6. Total Discounted Operational Savings	$143,375	
7. Savings to Investment Ratio (SIR)	1.42	(total discounted operational savings/total investment)
8. Adjusted Internal Rate of Return (AIRR)	4.82%	(1+d)*SIR^(1/n)-1; d=discount rate, n=years in study period

PL5: NIST BLCC 5.3-05: ECIP Report

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

The LCC calculations are based on the FEMP discount rates and energy price escalation rates updated on 1 April 2005.

Location:	Illinois	Discount Rate:	3%
Project Title:	Insulate hot plating tanks & rinse tanks	Analyst:	Underwood
Base Date:	1 October 2005	Preparation Date:	Wed Aug 03 15:39:41 CDT 2005
BOD:	1 October 2005	Economic Life:	20 yrs 0 months
File Name:	C:\Program Files\BLCC5\projects\PL5.xml		

1. Investment

Construction Cost	$2,376
SIOH	$135
Design Cost	$0
Total Cost	$2,511
Salvage Value of Existing Equipment	$0
Public Utility Company	$0
Total Investment	$2,511

2. Energy and Water Savings (+) or Cost (-)

Base Date Savings, unit costs, & discounted savings

Item	Unit Cost	Usage Savings	Annual Savings	Discount Factor	Discounted Savings
Coal	$5.61500	930.0 MBtu	$5,222	14.950	$78,067
Energy Subtotal		930.0 MBtu	$5,222		$78,067
Water Subtotal		0.0 Mgal	$0		$0
Total			$5,222		$78,067

3. Non-Energy Savings (+) or Cost (-)

Item	**Savings/Cost**	**Occurrence**	**Discount Factor**	**Discounted Savings/Cost**
Non-Annually Recurring				
Non-Annually Recurring Subtotal	$0			$0
Total	$0			$0

4. First year savings	$5,222	
5. Simple Payback Period (in years)	0.48	(total investment/first-year savings)
6. Total Discounted Operational Savings	$78,067	
7. Savings to Investment Ratio (SIR)	31.09	(total discounted operational savings/total investment)
8. Adjusted Internal Rate of Return (AIRR)	22.31%	(1+d)*SIR^(1/n)-1; d=discount rate, n=years in study period

PL6: NIST BLCC 5.3-05: ECIP Report

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

The LCC calculations are based on the FEMP discount rates and energy price escalation rates updated on 1 April 2005.

Location:	Illinois	Discount Rate:	3%
Project Title:	Retrofit MAUs with Low P Filters	Analyst:	Underwood
Base Date:	1 October 2005	Preparation Date:	Mon Aug 01 13:39:49 CDT 2005
BOD:	1 October 2005	Economic Life:	20 yrs 0 months
File Name:	C:\Program Files\BLCC5\projects\PL6.xml		

1. Investment

Construction Cost	$73,260
SIOH	$4,176
Design Cost	$0
Total Cost	$77,436
Salvage Value of Existing Equipment	$0
Public Utility Company	$0
Total Investment	$77,436

2. Energy and Water Savings (+) or Cost (-)

Base Date Savings, unit costs, & discounted savings

Item	Unit Cost	Usage Savings	Annual Savings	Discount Factor	Discounted Savings
Electricity	$6.63513	887.7 MBtu	$5,890	15.091	$88,891
Demand Savings			$2,269	15.091	$34,242
Energy Subtotal		887.7 MBtu	$8,159		$123,133
Water Subtotal		0.0 Mgal	$0		$0
Total			$8,159		$123,133

3. Non-Energy Savings (+) or Cost (-)

Item	**Savings/Cost**	**Occurrence**	**Discount Factor**	**Discounted Savings/Cost**
Non-Annually Recurring				
Non-Annually Recurring Subtotal	$0			$0
Total	$0			$0

4. First year savings	$8,159	
5. Simple Payback Period (in years)	9.49	(total investment/first-year savings)
6. Total Discounted Operational Savings	$123,133	
7. Savings to Investment Ratio (SIR)	1.59	(total discounted operational savings/total investment)
8. Adjusted Internal Rate of Return (AIRR)	5.42%	(1+d)*SIR^(1/n)-1; d=discount rate, n=years in study period

PN1: NIST BLCC 5.3-05: ECIP Report

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

The LCC calculations are based on the FEMP discount rates and energy price escalation rates updated on 1 April 2005.

Location:	Illinois	Discount Rate:	3%
Project Title:	Enclose paint booth#1 in B208	Analyst:	Underwood
Base Date:	1 October 2005	Preparation Date:	Wed Aug 03 16:00:16 CDT 2005
BOD:	1 October 2005	Economic Life:	20 yrs 0 months
File Name:	C:\Program Files\BLCC5\projects\PN1.xml		

1. Investment

Construction Cost	$75,460
SIOH	$4,300
Design Cost	$0
Total Cost	$79,760
Salvage Value of Existing Equipment	$0
Public Utility Company	$0
Total Investment	$79,760

2. Energy and Water Savings (+) or Cost (-)

Base Date Savings, unit costs, & discounted savings

Item	Unit Cost	Usage Savings	Annual Savings	Discount Factor	Discounted Savings
Electricity	$6.63513	655.0 MBtu	$4,346	15.091	$65,587
Coal	$5.61500	2,972.0 MBtu	$16,688	14.950	$249,480
Energy Subtotal		3,627.0 MBtu	$21,034		$315,067
Water Subtotal		0.0 Mgal	$0		$0
Total			$21,034		$315,067

3. Non-Energy Savings (+) or Cost (-)

Item	Savings/Cost	Occurrence	Discount Factor	Discounted Savings/Cost
Non-Annually Recurring				
Non-Annually Recurring Subtotal	$0			$0
Total	$0			$0

4. First year savings	$21,034	
5. Simple Payback Period (in years)	3.79	(total investment/first-year savings)
6. Total Discounted Operational Savings	$315,067	
7. Savings to Investment Ratio (SIR)	3.95	(total discounted operational savings/total investment)
8. Adjusted Internal Rate of Return (AIRR)	10.32%	(1+d)*SIR^(1/n)-1; d=discount rate, n=years in study period

PN2: NIST BLCC 5.3-05: ECIP Report

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

The LCC calculations are based on the FEMP discount rates and energy price escalation rates updated on 1 April 2005.

Location:	Illinois	Discount Rate:	3%
Project Title:	Enclose paint booth2 in B208	Analyst:	Underwood
Base Date:	1 October 2005	Preparation Date:	Wed Aug 03 16:04:28 CDT 2005
BOD:	1 October 2005	Economic Life:	20 yrs 0 months
File Name:	C:\Program Files\BLCC5\projects\PN2.xml		

1. Investment

Construction Cost	$125,290
SIOH	$7,140
Design Cost	$0
Total Cost	$132,430
Salvage Value of Existing Equipment	$0
Public Utility Company	$0
Total Investment	$132,430

2. Energy and Water Savings (+) or Cost (-)

Base Date Savings, unit costs, & discounted savings

Item	Unit Cost	Usage Savings	Annual Savings	Discount Factor	Discounted Savings
Electricity	$6.63513	492.1 MBtu	$3,265	15.091	$49,276
Coal	$5.61500	3,122.0 MBtu	$17,530	14.950	$262,071
Demand Savings			$458	15.091	$6,912
Energy Subtotal		3,614.1 MBtu	$21,253		$318,259
Water Subtotal		0.0 Mgal	$0		$0
Total			$21,253		$318,259

3. Non-Energy Savings (+) or Cost (-)

Item	**Savings/Cost**	**Occurrence**	**Discount Factor**	**Discounted Savings/Cost**
Non-Annually Recurring				
Non-Annually Recurring Subtotal	$0			$0
Total	$0			$0

4. First year savings	$21,253	
5. Simple Payback Period (in years)	6.23	(total investment/first-year savings)
6. Total Discounted Operational Savings	$318,259	
7. Savings to Investment Ratio (SIR)	2.40	(total discounted operational savings/total investment)
8. Adjusted Internal Rate of Return (AIRR)	7.62%	(1+d)*SIR^(1/n)-1; d=discount rate, n=years in study period

PN3: NIST BLCC 5.3-05: ECIP Report

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

The LCC calculations are based on the FEMP discount rates and energy price escalation rates updated on 1 April 2005.

Location:	Illinois	Discount Rate:	3%
Project Title:	Paint booth 4 improvement in B299	Analyst:	Underwood
Base Date:	1 October 2005	Preparation Date:	Mon Aug 01 14:10:56 CDT 2005
BOD:	1 October 2005	Economic Life:	20 yrs 0 months
File Name:	C:\Program Files\BLCC5\projects\PN3.xml		

1. Investment

Construction Cost	$137,995
SIOH	$7,865
Design Cost	$0
Total Cost	$145,860
Salvage Value of Existing Equipment	$0
Public Utility Company	$0
Total Investment	$145,860

2. Energy and Water Savings (+) or Cost (-)

Base Date Savings, unit costs, & discounted savings

Item	Unit Cost	Usage Savings	Annual Savings	Discount Factor	Discounted Savings
Electricity	$6.63513	529.4 MBtu	$3,513	15.091	$53,011
Coal	$5.61500	13,386.0 MBtu	$75,162	14.950	$1,123,665
Energy Subtotal		13,915.4 MBtu	$78,675		$1,176,677
Water Subtotal		0.0 Mgal	$0		$0
Total			$78,675		$1,176,677

3. Non-Energy Savings (+) or Cost (-)

Item	Savings/Cost	Occurrence	Discount Factor	Discounted Savings/Cost
Annually Recurring	$36,000	Annual	15.099	$543,570
Non-Annually Recurring				
Non-Annually Recurring Subtotal	$0			$0
Total	$36,000			$543,570

4. First year savings	$114,675	
5. Simple Payback Period (in years)	1.27	(total investment/first-year savings)
6. Total Discounted Operational Savings	$1,720,247	
7. Savings to Investment Ratio (SIR)	11.79	(total discounted operational savings/total investment)
8. Adjusted Internal Rate of Return (AIRR)	16.53%	(1+d)*SIR^(1/n)-1; d=discount rate, n=years in study period

PN4: NIST BLCC 5.3-05: ECIP Report

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

The LCC calculations are based on the FEMP discount rates and energy price escalation rates updated on 1 April 2005.

Location:	Illinois	Discount Rate:	3%
Project Title:	Paint booth 5 improvement in B299	Analyst:	Underwood
Base Date:	1 October 2005	Preparation Date:	Wed Aug 03 16:13:21 CDT 2005
BOD:	1 October 2005	Economic Life:	20 yrs 0 months
File Name:	C:\Program Files\BLCC5\projects\PN4.xml		

1. Investment

Construction Cost	$46,970
SIOH	$2,680
Design Cost	$0
Total Cost	$49,650
Salvage Value of Existing Equipment	$0
Public Utility Company	$0
Total Investment	$49,650

2. Energy and Water Savings (+) or Cost (-)

Base Date Savings, unit costs, & discounted savings

Item	Unit Cost	Usage Savings	Annual Savings	Discount Factor	Discounted Savings
Electricity	$6.63513	227.9 MBtu	$1,512	15.091	$22,816
Coal	$5.61500	10,971.0 MBtu	$61,602	14.950	$920,942
Energy Subtotal		11,198.9 MBtu	$63,114		$943,758
Water Subtotal		0.0 Mgal	$0		$0
Total			$63,114		$943,758

3. Non-Energy Savings (+) or Cost (-)

Item	Savings/Cost	Occurrence	Discount Factor	Discounted Savings/Cost
Non-Annually Recurring				
Non-Annually Recurring Subtotal	$0			$0
Total	$0			$0

4. First year savings	$63,114	
5. Simple Payback Period (in years)	0.79	(total investment/first-year savings)
6. Total Discounted Operational Savings	$943,758	
7. Savings to Investment Ratio (SIR)	19.01	(total discounted operational savings/total investment)
8. Adjusted Internal Rate of Return (AIRR)	19.34%	(1+d)*SIR^(1/n)-1; d=discount rate, n=years in study period

WD1: NIST BLCC 5.3-05: ECIP Report

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

The LCC calculations are based on the FEMP discount rates and energy price escalation rates updated on 1 April 2005.

Location:	Illinois	Discount Rate:	3%
Project Title:	Install ergonomic extraction arms	Analyst:	Underwood
Base Date:	1 October 2005	Preparation Date:	Wed Aug 03 16:38:06 CDT 2005
BOD:	1 October 2005	Economic Life:	20 yrs 0 months
File Name:	C:\Program Files\BLCC5\projects\WD1.xml		

1. Investment

Construction Cost	$115,000
SIOH	$6,555
Design Cost	$0
Total Cost	$121,555
Salvage Value of Existing Equipment	$0
Public Utility Company	$0
Total Investment	$121,555

2. Energy and Water Savings (+) or Cost (-)

Base Date Savings, unit costs, & discounted savings

Item	Unit Cost	Usage Savings	Annual Savings	Discount Factor	Discounted Savings
Electricity	$7.61985	122.8 MBtu	$935	15.091	$14,117
Coal	$5.61500	1,469.0 MBtu	$8,248	14.950	$123,313
Energy Subtotal		1,591.8 MBtu	$9,184		$137,430
Water Subtotal		0.0 Mgal	$0		$0
Total			$9,184		$137,430

3. Non-Energy Savings (+) or Cost (-)

Item	Savings/Cost	Occurrence	Discount Factor	Discounted Savings/Cost
Non-Annually Recurring				
Non-Annually Recurring Subtotal	$0			$0
Total	$0			$0

4. First year savings	$9,184	
5. Simple Payback Period (in years)	13.24	(total investment/first-year savings)
6. Total Discounted Operational Savings	$137,430	
7. Savings to Investment Ratio (SIR)	1.13	(total discounted operational savings/total investment)
8. Adjusted Internal Rate of Return (AIRR)	3.63%	(1+d)*SIR^(1/n)-1; d=discount rate, n=years in study period

WD2: NIST BLCC 5.3-05: ECIP Report

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

The LCC calculations are based on the FEMP discount rates and energy price escalation rates updated on 1 April 2005.

Location:	Illinois	Discount Rate:	3%
Project Title:	Install improved ventilation system	Analyst:	Underwood
Base Date:	1 October 2005	Preparation Date:	Wed Aug 03 16:49:43 CDT 2005
BOD:	1 October 2005	Economic Life:	20 yrs 0 months
File Name:	C:\Program Files\BLCC5\projects\WD2.xml		

1. Investment

Construction Cost	$15,000
SIOH	$855
Design Cost	$0
Total Cost	$15,855
Salvage Value of Existing Equipment	$0
Public Utility Company	$0
Total Investment	$15,855

2. Energy and Water Savings (+) or Cost (-)

Base Date Savings, unit costs, & discounted savings

Item	Unit Cost	Usage Savings	Annual Savings	Discount Factor	Discounted Savings
Electricity	$6.65892	778.9 MBtu	$5,187	15.091	$78,273
Coal	$5.61500	4,892.0 MBtu	$27,469	14.950	$410,651
Demand Savings			$2,850	15.091	$43,010
Energy Subtotal		5,670.9 MBtu	$35,505		$531,934
Water Subtotal		0.0 Mgal	$0		$0
Total			$35,505		$531,934

3. Non-Energy Savings (+) or Cost (-)

Item	Savings/Cost	Occurrence	Discount Factor	Discounted Savings/Cost
Non-Annually Recurring				
Non-Annually Recurring Subtotal	$0			$0
Total	$0			$0

4. First year savings	$35,505	
5. Simple Payback Period (in years)	0.45	(total investment/first-year savings)
6. Total Discounted Operational Savings	$531,934	
7. Savings to Investment Ratio (SIR)	33.55	(total discounted operational savings/total investment)
8. Adjusted Internal Rate of Return (AIRR)	22.78%	(1+d)*SIR^(1/n)-1; d=discount rate, n=years in study period

BE1: NIST BLCC 5.3-05: ECIP Report

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

The LCC calculations are based on the FEMP discount rates and energy price escalation rates updated on 1 April 2005.

Location:	Illinois	Discount Rate:	3%
Project Title:	Improving B220 working condition & IAQ	Analyst:	Underwood
Base Date:	1 October 2005	Preparation Date:	Wed Aug 03 17:02:54 CDT 2005
BOD:	1 October 2005	Economic Life:	20 yrs 0 months
File Name:	C:\Program Files\BLCC5\projects\BE1.xml		

1. Investment

Construction Cost	$258,500
SIOH	$14,735
Design Cost	$0
Total Cost	$273,235
Salvage Value of Existing Equipment	$0
Public Utility Company	$0
Total Investment	$273,235

2. Energy and Water Savings (+) or Cost (-)

Base Date Savings, unit costs, & discounted savings

Item	Unit Cost	Usage Savings	Annual Savings	Discount Factor	Discounted Savings
Electricity	$6.63513	593.0 MBtu	$3,935	15.091	$59,381
Coal	$5.61500	10,277.0 MBtu	$57,705	14.950	$862,686
Energy Subtotal		10,870.0 MBtu	$61,640		$922,067
Water Subtotal		0.0 Mgal	$0		$0
Total			$61,640		$922,067

3. Non-Energy Savings (+) or Cost (-)

Item	Savings/Cost	Occurrence	Discount Factor	Discounted Savings/Cost
Non-Annually Recurring				
Non-Annually Recurring Subtotal	$0			$0
Total	$0			$0

4. First year savings	$61,640	
5. Simple Payback Period (in years)	4.43	(total investment/first-year savings)
6. Total Discounted Operational Savings	$922,067	
7. Savings to Investment Ratio (SIR)	3.37	(total discounted operational savings/total investment)
8. Adjusted Internal Rate of Return (AIRR)	9.46%	(1+d)*SIR^(1/n)-1; d=discount rate, n=years in study period

BE2: NIST BLCC 5.3-05: ECIP Report

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

The LCC calculations are based on the FEMP discount rates and energy price escalation rates updated on 1 April 2005.

Location:	Illinois	Discount Rate:	3%
Project Title:	Install high speed door	Analyst:	Underwood
Base Date:	1 October 2005	Preparation Date:	Wed Aug 03 17:10:21 CDT 2005
BOD:	1 October 2005	Economic Life:	20 yrs 0 months
File Name:	C:\Program Files\BLCC5\projects\BE2.xml		

1. Investment

Construction Cost	$60,500
SIOH	$3,450
Design Cost	$0
Total Cost	$63,950
Salvage Value of Existing Equipment	$0
Public Utility Company	$0
Total Investment	$63,950

2. Energy and Water Savings (+) or Cost (-)

Base Date Savings, unit costs, & discounted savings

Item	Unit Cost	Usage Savings	Annual Savings	Discount Factor	Discounted Savings
Coal	$5.61500	7,677.0 MBtu	$43,106	14.950	$644,433
Energy Subtotal		7,677.0 MBtu	$43,106		$644,433
Water Subtotal		0.0 Mgal	$0		$0
Total			$43,106		$644,433

3. Non-Energy Savings (+) or Cost (-)

Item	Savings/Cost	Occurrence	Discount Factor	Discounted Savings/Cost
Non-Annually Recurring				
Non-Annually Recurring Subtotal	$0			$0
Total	$0			$0

4. First year savings	$43,106	
5. Simple Payback Period (in years)	1.48	(total investment/first-year savings)
6. Total Discounted Operational Savings	$644,433	
7. Savings to Investment Ratio (SIR)	10.08	(total discounted operational savings/total investment)
8. Adjusted Internal Rate of Return (AIRR)	15.61%	(1+d)*SIR^(1/n)-1; d=discount rate, n=years in study period

BH9: NIST BLCC 5.3-05: ECIP Report

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

The LCC calculations are based on the FEMP discount rates and energy price escalation rates updated on 1 April 2005.

Location:	Illinois	Discount Rate:	3%
Project Title:	Perform further energy saving in B222	Analyst:	Underwood
Base Date:	1 October 2005	Preparation Date:	Wed Aug 03 17:05:50 CDT 2005
BOD:	1 October 2005	Economic Life:	20 yrs 0 months
File Name:	C:\Program Files\BLCC5\projects\BH9.xml		

1. Investment

Construction Cost	$2,500
SIOH	$142
Design Cost	$0
Total Cost	$2,642
Salvage Value of Existing Equipment	$0
Public Utility Company	$0
Total Investment	$2,642

2. Energy and Water Savings (+) or Cost (-)

Base Date Savings, unit costs, & discounted savings

Item	Unit Cost	Usage Savings	Annual Savings	Discount Factor	Discounted Savings
Electricity	$6.63513	334.5 MBtu	$2,219	15.091	$33,491
Energy Subtotal		334.5 MBtu	$2,219		$33,491
Water Subtotal		0.0 Mgal	$0		$0
Total			$2,219		$33,491

3. Non-Energy Savings (+) or Cost (-)

Item	Savings/Cost	Occurrence	Discount Factor	Discounted Savings/Cost
Non-Annually Recurring				
Non-Annually Recurring Subtotal	$0			$0
Total	$0			$0

4. First year savings	$2,219	
5. Simple Payback Period (in years)	1.19	(total investment/first-year savings)
6. Total Discounted Operational Savings	$33,491	
7. Savings to Investment Ratio (SIR)	12.68	(total discounted operational savings/total investment)
8. Adjusted Internal Rate of Return (AIRR)	16.95%	(1+d)*SIR^(1/n)-1; d=discount rate, n=years in study period

LT1: NIST BLCC 5.3-05: ECIP Report

Consistent with Federal Life Cycle Cost Methodology and Procedures, 10 CFR, Part 436, Subpart A

The LCC calculations are based on the FEMP discount rates and energy price escalation rates updated on 1 April 2005.

Location:	Illinois	Discount Rate:	3%
Project Title:	Install task lamps in areas req. add. lighting	Analyst:	Underwood
Base Date:	1 October 2005	Preparation Date:	Wed Aug 03 17:07:25 CDT 2005
BOD:	1 October 2005	Economic Life:	20 yrs 0 months
File Name:	C:\Program Files\BLCC5\projects\LT1.xml		

1. Investment

Construction Cost	$68,200
SIOH	$3,887
Design Cost	$0
Total Cost	$72,087
Salvage Value of Existing Equipment	$0
Public Utility Company	$0
Total Investment	$72,087

2. Energy and Water Savings (+) or Cost (-)

Base Date Savings, unit costs, & discounted savings

Item	Unit Cost	Usage Savings	Annual Savings	Discount Factor	Discounted Savings
Electricity	$6.63513	-170.4 MBtu	-$1,130	15.091	-$17,058
Energy Subtotal		-170.4 MBtu	-$1,130		-$17,058
Water Subtotal		0.0 Mgal	$0		$0
Total			-$1,130		-$17,058

3. Non-Energy Savings (+) or Cost (-)

Item	Savings/Cost	Occurrence	Discount Factor	Discounted Savings/Cost
Annually Recurring	$60,000	Annual	15.099	$905,950
Non-Annually Recurring				
Non-Annually Recurring Subtotal	$0			$0
Total	$60,000			$905,950

4. First year savings	$58,870	
5. Simple Payback Period (in years)	1.22	(total investment/first-year savings)
6. Total Discounted Operational Savings	$888,892	
7. Savings to Investment Ratio (SIR)	12.33	(total discounted operational savings/total investment)
8. Adjusted Internal Rate of Return (AIRR)	16.79%	(1+d)*SIR^(1/n)-1; d=discount rate, n=years in study period

Appendix C: ECIP Guidance (APR 05)

Energy Conservation Investment Program (ECIP) Guidance

1. DEFINITION: ECIP is a subset of the Military Construction (MILCON) program specifically designated for energy saving projects for facilities. It is used to fund any MILCON scope projects that are initiated to reduce energy use through construction of new, high efficiency energy systems or the improvement and modernization of existing Army owned energy systems, buildings, or facilities for which the Department of the Army pays for the energy.

2. SCOPE: The projected Department of Defense (DOD) funding level of ECIP, not including design, is $50 million per year. The Army share of funding is expected to be approximately $20 million per year or up to $100 million over 5 years. A sufficient supply of competitive ECIP projects can result in an increase in Army share of DOD funding for any given fiscal year.

3. GENERAL:

a. Congress appropriates funding for the Energy Conservation Investment Program to execute projects that save energy or reduce energy costs. DOD manages the overall program http://www.acq.osd.mil/ie/irm/Energy/Energy.htm and funds are allocated on a fair share basis based on DOD Component's previous year reported facility energy use and factoring in the obligation rate for the last 5 years. This approach allows management of the program with a degree of funding certainty and encourages timely execution.

b. At the discretion of the Army, up to 10 percent of its annual ECIP target budget may be programmed against renewable energy applications that do not necessarily meet the SIR and payback criteria in order to expand use of renewable energy applications and to meet the goals of Executive Order 13123 "Greening the Government through Efficient Energy Management."

c. Additional assistance in identifying and developing energy projects can be found on the Army Energy web site http://hqda-energypolicy.pnl.gov/. Projects which implement renewable energy opportunities as shown in the recent DOD Renewable

Energy Resource Assessment, http://www.acq.osd.mil/ie/irm/Energy/Energy.htm, and other goals of E.O. 13123 will be given subjective consideration for increased priority.

d. ECIP projects will be prioritized on the basis of the greatest life cycle payback as determined by the Savings-to-Investment-Ratio (SIR). The SIR will be calculated by the economic analysis method contained in this guidance and National Institute of Standards and Technology (NIST) Handbook 135, "Life Cycle Cost Manual for the Federal Energy Management Program" http://www.eere.energy.gov/femp/techassist/life_cycle_cost.html. The recommended simplified economic analysis summary format is provided in Appendix A.

e. A life cycle cost analysis for each overall project and for each discrete retrofit action (i.e., storm windows, insulation, economizer, etc.) will be performed and be included with the DD Form 1391 project documents submitted for consideration.

f. Overall projects and discrete portion of projects must have a SIR equal to or greater than 1.25.

h. All SIR calculations and analyses should be based upon the recommended economic life (See Appendix B), the useful life of the retrofit action, or the remaining life of the facility affected, whichever is least.

i. Present value discounting will be done using the current year discount factor (3.0%). Single Present Value (SPV) and Uniform Present Value (UPV) factors for use in determining present value of non-energy costs/savings are given in Tables A-1 and A-2 respectively. Uniform Present Value (UPV) factors for annual energy costs/savings for the various regions are given in Tables Ba-1 through Ba-5. Overseas installations will use the U.S. average (Table Ba-5). These present value factors are taken from NIST 3273-20, which is updated annually.

j. The estimated construction cost, the labor and material costs, and the actual current unit costs of the energy at the facility, rather than stock fund prices, will be used as the basis for energy cost analysis. (Stock fund prices might be out of date and include storage and other overhead costs.)

k. Care will be taken in computing energy savings to ensure that energy savings are not duplicated between projects or portions of projects.

l. Temporary Buildings

For each temporary building included in a project, separate documentation is required showing, a minimum 10 year continuing need for active building retention after retrofit, the specific retrofit action applicable and an economic analysis supporting the specific retrofit.

Temporary buildings in ECIP projects will be documented as included in an installations annual real property utilization survey. Projects for temporary buildings on semi-active installations should address areas where savings will result during seasonal use, e.g., hot water.

m. Non-Appropriated Funded Facilities

Non-appropriated funded facilities will not be included in an ECIP project without an accompanying statement certifying that utility costs are paid for by the Army with appropriated funds.

4. PROJECT DOCUMENTATION:

a. DD Forms 1391 will contain the notation "ECIP" in the title block and will include a line item identification, description, location, current working estimate (CWE), total project SIR, annual dollar savings and annual energy savings.

b. Project submittal will include copies of the life cycle analyses for the discrete portions and of the overall project. Supporting documentation consisting of basic engineering and economic calculations showing how savings were determined will be included in the submittal. Sample format of the analyses and summary sheet are provided in Appendix A. Computer generated summaries are acceptable provided they conform to the above guidance.

c. Project descriptions must clearly define the conservation measures from which the energy savings will result and the specific facilities being built or modified by the project.

d. The method to be used to measure and verify project savings must be included in the DD 1391 documentation under the project description.

e. Project documentation should include a statement, if appropriate, regarding whether the installation affected by the project is being considered for closure or realignment. If so, an explanation must be provided for why the project is being considered in face of the closure or realignment.

5. <u>ENERGY CONVERSIONS</u>:

a. For purposes of calculating energy savings, the following conversion factors are to be used:

Purchased Electric Power	3,413 Btu/kWh	3.6 MJ/kWh
Purchased Steam	1,340 Btu/lb	1.41 MJ/lb
Distillate Fuel Oil	138,700 Btu/gal	38.6 MJ/L
Natural Gas	1,031 Btu/cu ft	38.85 MJ/cu m
LPG, Propane, Butane	95,000 Btu/gal	24.6 MJ/L
Bituminous Coal	24,580,000 Btu/Short Ton	28,592 MJ/metric ton
Anthracite Coal	25,400,000 Btu/Short Ton	29,546 MJ/metric ton
Residual Fuel Oil	Average thermal content of oil at each installation	

b. Purchased energy is defined as being generated offsite. For special cases where electric power or steam is obtained from on-site sources, the actual average gross energy input to the generating plant will be used.

c. The term "coal" does not include lignite. Where lignite is involved, the Bureau of Mines average value for the source field shall be used.

d. Where is involved, the heat value shall be the average of the RDF being used or proposed.

e. When the average fuel oil heating value is accurately known through laboratory testing for a specific military installation, that value may be used in lieu of the amount specified in paragraph 5.a.

f. Full energy credit may be taken for conversion from fossil fuels or electric power to solar, wind, RDF, or geothermal energy less the calculated average yearly standby requirement.

6. <u>ECONOMIC ANALYSIS</u>: The savings-to-investment ratios and payback periods shall be arrived at using the following guidance:

a. Life Cycle Cost (LCC) analyses are to be performed on all projects, and discrete elements of projects, using the method required by 10 CFR, Part 436, Subpart A.

b. The National Institute of Standards and Technology (NIST) has developed the following three tools to assist in the economic analysis of candidate ECIP projects:

(1) <u>Life-Cycle Costing Manual for the Federal Energy Management Program</u>. NIST Handbook 135 (current version 1995)
http://www.bfrl.nist.gov/oae/publications/handbooks/135.pdf

(2) Energy Price Indices and Discount Factors for Economic Analysis), NISTIR 85-3273-20 (updated annually) which provides discount factors for life cycle analysis for 2005. http://www.eere.doe.gov/femp/pdfs/ashb05.pdf.

(3) NIST "Building Life Cycle Cost" (BLCC) Computer Program, Note: Used to provide computational support for the analysis of capital investments in buildings. - Latest version 5.3-05 located at
http://www.eere.doe.gov/femp/information/download_blcc.cfm

c. Actual cost of the energy purchased for use at the facility (i.e., cost to the Government, not Defense Energy Support Center (DESC) or Defense Base Operating Fund stock fund prices) will be used as the basis for energy cost analysis. The format to be used for ECIP Economic Analysis included in paragraph 11E of the DD Form 1391 submittal is given in Appendix A.

7. PROGRAMMING CRITERIA:

a. ECIP projects will be prioritized and ranked for funding on the basis of the greatest potential life-cycle payback for dollar invested as indicate by SIR.

b. Projects that substitute renewable energy for nonrenewable energy or include water conservation can be subjectively considered for increased priority based on the magnitude of their additional benefits.

c. Since there is uncertainty over future force level and base structure, a sensitivity analysis must be conducted to determine if there is likelihood that expected changes might alter the economic benefits. Increased risk identified as a result of this sensitivity analysis may be used to lower a project's programming priority.

d. The minimum economic return for inclusion of an ECIP project is a SIR greater than 1.25 and a simple payback period that is less than 10 years. Projects of longer pay back that are shown to support goals of Executive Order (EO) 13123 will be considered on a case basis.

e. Energy Monitoring and Control System projects must have the Garrison Commander's certification that appropriate resources will be committed to effectively operate the system over the life cycle of the investment.

f. Projects will be classified into one of the ten categories listed in Appendix B. A project will be classified under a category if at least 75 percent of the scope of work falls under that category. Projects that do not contain at least 75 percent of any category shall be classified as "Facility Energy Improvement" projects.

g. Realized saving should not only be auditable, but the description in the DD Form 1391 of proposed project shall identify the method to be used for savings verification.

h. Projects should only be submitted for ECIP funding if they are expected to directly produce energy savings/ cost reduction.

8. PROJECT EXECUTION:

a. DOD guidance requires that Components strive to obligate 100 percent of the ECIP funds provided by the end of third quarter in the fiscal year which the funds were issued.

b. At the end of the third quarter, any un-obligated funding at that point may, at the discretion of DOD, be pulled back and redistributed to another DOD Component poised to obligate against a valid design-complete project, with priority given to renewable energy projects.

9. PROGRAM REVIEW:

a. A program review will be conducted by DOD at mid-year to determine the status of the program execution and to verify the projected savings. In addition, the Defense Inspector General may make periodic audits of ECIP as part of the overall audit of the Energy Resource Management Program.

b. To maintain creditability of the ECIP and provide and explain current project data that is not in agreement with data as approved by DOD, it is essential that documentation be diligently maintained by installations, Installation Management Agency (IMA) Regions and Corps of Engineer Districts. The data should include scope and scope changes, design projection, and auditable trails of cost, cost avoidance, energy savings, savings to investment ratios, simple payback, etc. Each level of command should assist in maintaining the audit trails in order to provide quick positive response to DOD.

10. MANAGEMENT RESPONSIBILITIES: IMA Region Office and installation, Corps of Engineer Division and District, within their areas of responsibility, will:

a. Identify and accomplish all energy conservation measures with a 10 year or less payback;

b. Submit project documentation, through the normal Military Construction review and verification process, to the Assistant Chief of Staff for Installation Management;

c. Ensure that all cost-effective low-cost/no-cost conservation and rehabilitation actions that would reduce an individual ECIP project scope, and are executable within available installation resources, are taken prior to project development;

d. Ensure that all projects are designed and constructed within the original scope as forwarded to Congress and within funds allocated by the OSD comptroller;

e. Ensure that all monies authorized and appropriated for ECIP are used for energy conservation purposes;

f. Reevaluate savings estimates and program compliance whenever scope, savings or cost estimates change by more than 25 percent;

g. Revalidate all projects prior to requesting advertising authority to ensure that contemplated benefits will still accrue;

h. Maintain current, auditable documentation on execution status and the projected and realized savings for each approved ECIP project. Auditable documentation includes section 11C and 11D of the DD 1391, including basic engineering and economic calculations;

i. Provide information for annual report on the status of the ECIP for incorporation by DOD in Department of Energy's report to Congress.

DISCOUNT FACTORS FOR NON-ENERGY COSTS/ SAVINGS

The SPV factors (Table A-1) for finding present value of single costs/ savings (non-fuel) and the UPV factors (Table A-2) for finding present value of annual recurring uniform costs (non-fuel) are based on a 3.0% discount rate.

Table A - 1. SPV factors

STUDY PERIOD YEARS	SPV FACTOR
1	0.971
2	0.943
3	0.915
4	0.888
5	0.863
6	0.837
7	0.813
8	0.789
9	0.766
10	0.744
11	0.722
12	0.701
13	0.681
14	0.661
15	0.642
16	0.623
17	0.605
18	0.587
19	0.570
20	0.554
21	0.538
22	0.522
23	0.507
24	0.492
25	0.478
26	0.464
27	0.450
28	0.437
29	0.424
30	0.412

Table A- 2. UPV factors.

STUDY PERIOD YEARS	UPV FACTOR
1	0.97
2	1.91
3	2.83
4	3.72
5	4.58
6	5.42
7	6.23
8	7.02
9	7.79
10	8.53
11	9.25
12	9.95
13	10.63
14	11.30
15	11.94
16	12.56
17	13.17
18	13.75
19	14.32
20	14.88
21	15.42
22	15.94
23	16.44
24	16.94
25	17.41
26	17.88
27	18.33
28	18.76
29	19.19
30	19.60

Tables Ba-1 Through Ba-5

Discount Factors Adjusted for Energy Price Escalation

The following “modified” uniform present value (UPV*) discount factors are based on a 3.0% discount rate and include the projected escalation rates in energy prices from 2006 to 2035 for the 4 Census Regions and the United States average. The factors are modified in the sense that they incorporate projected energy prices changes. The UPV* factors incorporate rates of change in energy prices computed from indices projected by the Energy Information Administration (EIA) of the U.S. Department of Energy. Current discount factors for Census Regions and U.S. Average are given in the Tables Ba-1thru Ba-5 and are also provided NISTR 3273-20 (pp 15-19) located at http://www.eere.doe.gov/femp/pdfs/ashb05.pdf.

Table Ba-1 - CENSUS REGION 1: Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania

Table Ba-2 - CENSUS REGION 2: Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas

Table Ba-3 - CENSUS REGION 3: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, Texas

Table Ba-4 - CENSUS REGION 4: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Alaska, Hawaii

Table Ba-5 - U. S. AVERAGE: United States Average to be used for all OCONUS

Annex A

General

The Summary form is to be used for determining Savings to Investment Ratios (SIR) for complete ECIP projects and for discrete portions of projects. In using this form, the cost of construction; supervision; inspection and overhead (SIOH); design costs, salvage value; unit costs of energy; and recurring and nonrecurring non-energy costs are determined as of the date the analysis is made.

Title Block

Identify project title (see Appendix B), and if applicable, the discrete portion of the project being analyzed. The installation region is determined by its location (see Census Regions 1 through 4). (OCONUS use U.S. Average). The economic life is the period of time over which the savings from a project may reasonably be expected to accrue (see Appendix B).

Line 1 Investment Cost

All investment costs are determined as of the date the analysis is made. Salvage value is the residual value of existing equipment removed as a result of the retrofit project. Investment costs do not include energy audit costs, preliminary design, nor analysis costs since these efforts are required by Executive Order, legislation, or DOD requirements and are therefore considered sunk costs.

Line 2 Energy Savings

By definition ECIP projects must save money, therefore there will always be an overall energy cost savings. The overall savings may include increases in use of one fuel and an decrease in use another. Use conversion factors in paragraph 3 of the guidance to convert to MBTU units. (On the economic summary sheet indicate energy savings and unit energy costs in MBtus.) If the energy source fuel type is not listed, include it under line 2G. The cost per MBTU (1) is the cost of energy at the installation on the date of the analysis. For each fuel, retain information to show and substantiate the energy savings (2) claimed. The annual savings is the product of (1) x (2). The discount (UPV*) factors (4) are obtained from the appropriate table Ba-1 through Ba-5. For energy sources not listed in tables 1 through 5 and demand savings, use the UPV factors from Table A-2. The discounted savings over the economic life (5) are determined by multiplying (3) x (4).

Line 3 Non-Energy Savings

Annual recurring savings/costs will include items such as electrical demand savings, operator/maintenance savings (labor and materials). Non-recurring savings/costs will include periodic maintenance and integral parts replacement costs. All costs are to be estimated as if they will be incurred on the analysis date. Include backup data substantiating all costs/savings. For each non-recurring item enter the analysis years in which it occurs, obtain the discount (SPV) factor from Table A-1 and calculate the discounted savings/costs by multiplying (1) x (3). For annual savings/costs obtain the discount (UPV) factor from Table A-2.

Line 4

The first year dollar savings is defined as the summation of the first year energy and non-energy savings plus the total nonrecurring non-energy savings divided by the economic life of the retrofit action (2I3 + 3A + (3Bd1/years economic life)).

Line 5

The simple payback is equal to the total investment divided by the first year dollar savings (1G/4).

Line 6

Total net discounted savings equals the energy discounted savings plus the total non-energy discounted savings (2I5 + 3C).

Line 7

Savings-to-investment ratio equals the net discounted savings divided by the total investment (6/1G). The project qualifies for inclusion in the program if SIR on Line 7 is equal to or greater than 1.25.

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LOCATION:____
REGION NO.______
PROJECT NO._____________
PROJECT TITLE:____
FISCAL YEAR_____
ANALYSIS DATE:_______________

ECONOMIC_LIFE_______

PREPARER______________________________

1. INVESTMENT COSTS:

a. CONSTRUCTION COST	$____________
B. SIOH	$____________
C. DESIGN COST	$____________
D. TOTAL COST (1A+1B+1C)	$____________
E. SALVAGE VALUE of EXISTING EQUIPMENT	$____________
F. PUBLIC UTILITY COMPANY REBATE	$____________
G. TOTAL INVESTMENT (1D-1E-1F)	$____________

2. ENERGY SAVINGS (+)/COST(-):

DATE of NISTR 3273-18 USED for DISCOUNT FACTOR S ____________

ENERGY SOURCE	COST $/MBTU(1)	SAVING MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
a. ELEC	$_______	_________	$_________	__________	$___________
B. DIST	$_______	_________	$_________	__________	$___________
C. RESID	$_______	_________	$_________	__________	$___________
D. NG	$_______	_________	$_________	__________	$___________
E. PPG	$_______	_________	$_________	__________	$___________
F. COAL	$_______	_________	$_________	__________	$___________
G. _____	$_______	_________	$_________	__________	$___________
H. DEMAND SAVINGS			$_________	__________	$___________
I. TOTAL		_________	$_________		$___________

3. NON-ENERGY SAVINGS (+) or COST (-):

a. ANNUAL RECURRING (+/-) $_________

(1) DISCOUNT FACTOR (TABLE a-2) __________

(2) DISCOUNTED SAVINGS/COST (3A X 3A1) $___________

B. NON-RECURRING SAVINGS (+) or COST (-) (TABLE a-1)

ITEM	SAVINGS(+) COST(-)(1)	YEAR of OCCUR. (2)	DISCOUNT FACTOR (3)	DISCOUNTED SAVINGS/ COST(+/-)(4)
a.___________	$_________	_________	___________	$_______________
B.___________	$_________	_________	___________	$_______________
C.___________	$_________	_________	___________	$_______________
D. TOTAL	$_________			$_______________

C. TOTAL NON-ENERGY DISCOUNTED SAVINGS (3A2+3B4D) $___________

4. FIRST YEAR DOLLAR SAVINGS (2I3+3A+(3BD1/YRS ECON LIFE)): ___________

5. SIMPLE PAYBACK (1G/4): ________YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2I5+3C): $___________

7. SAVINGS to INVESTMENT RATIO (SIR) 6/1G: ___________

Annex B: Energy Conservation Project Types

Recommended Economic Analysis Life

Category	Title	Description
1.	EMCS or HVAC Controls (10 years)	Projects that centrally control energy systems with the ability to automatically adjust temperature, shed electrical loads, control motor speeds or adjust lighting intensities.
2.	Steam and Condensate	Projects to install condensate lines, cross connect Systems lines, distribution system loops, repair or install (20 years) Insulation and steam flow meters and controls.
3.	Boiler Plant Modifications (20 years)	Projects to upgrade or replace central boilers or ancillary equipment to improve overall efficiency. This includes fuel switching of dual fuel conversions.
4.	Heating, Ventilating, Air-Conditioning (HVAC) (20 years)	Projects to install more energy efficient heating, cooling, ventilation or hot water heating equipment. This includes the HVAC distribution systems (ducts, pipes, etc).
5.	Weatherization (20 years)	Projects improving the thermal envelope of a building. This includes building insulation (wall, roof, foundation), insulated doors, windows, vestibules, earth berm design, shading, etc).
6.	Lighting Systems (15 years)	Projects to install replacement lighting systems and controls. This would include day-lighting, new fixtures, lamps, ballasts, photocells, motion sensors, IR sensors, light wells, highly reflective painting, etc.
7.	Energy Recovery Systems (20 years)	Projects to install heat exchangers, regenerators, heat reclaim units or recapture energy lost to the environment.
8.	Electrical Energy Systems (20 years)	Projects that will increase the energy efficiency of an electrical device or system or reduce cost by reducing peak demand.
9.	Renewable Energy Systems (20 years)	Any project utilizing renewable energy. This includes active solar heating, cooling, hot water, industrial process heat, photovoltaic, wind, biomass, geothermal, and passive solar applications.
10.	Facility Energy Improvements (20 years)	Multiple category projects or those that do not fall into any other category.

Annex C: FY 2007 Process Summary

Energy Conservation Investment Program (ECIP)

The Office of Assistant Chief of Staff for Installation Management (OACSIM) provides HQ-IMA/ Regions with ECIP guidance on project development, submittal, and economic analysis. The Army installations use this guidance to prepare projects (DD Form 1391) and develop the project economic analysis. The economic analysis provides the Savings to Investment Ratio (SIR) and simple payback period which is compared to program criteria requiring an SIR greater than or equal to 1.25 and payback of 10 years or less. Installations then submit information on qualified projects to the IMA Regions, who review the projects and the economic analyses. Once this review is completed, they consolidate and submit all Region projects to HQ IMA for further review and Army-wide consolidation. HQ IMA submits the consolidated list with proposed rankings to the OACSIM.

The OACSIM performs final reviews and ranking of all the Army installation projects for the Energy Conservation Investment Program and identifies candidate projects for submission to the Office of the Secretary of Defense (OSD). The projects are forwarded through the DASA(I&H) for official endorsement, before they are submitted to OSD. OSD then consolidates all the Services and Defense Agency projects and selects the projects for the program to be submitted with the President's Budget in January 2006. The OACSIM authorizes USACE to initiate the design on projects identified by OSD for funding so that projects will be ready to advertise the beginning of Fiscal Year 2007.

After the appropriation becomes available in Fiscal Year 2007, OSD validates the funding list for all Services and notifies Congress of the intent to execute the ECIP projects. The Congressional notification waiting period is 21 days. Once the waiting period is over, the project funds are transferred by OSD Comptroller directly to U.S. Army Corps of Engineers (USACE). The USACE program manager executes the projects through Corps of Engineer Districts. In some cases, with the concurrence of District Engineer project manager, the installation awards the project. The OACSIM tracks progress with USACE and reports on execution status to OSD during the Fiscal Year.

The following is approximate timeline for FY07 ECIP program development:

- Apr 05 — OACSIM project request sent to HQ IMA/ Regions
- 30 Jul 05 — HQ IMA submits candidate projects to OACSIM
- Aug 05 — OACSIM develops tentative FY07 project list

- Sep 05 — Project Review Panel (OACSIM/ HQ IMA) confirms projects
- Sep 05 — OACSIM prepares and coordinates OSD FY07 submission
- Oct 05 — OACSIM submits proposed list through DASA(I&H) to OSD.

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14. ABSTRACT

In summer 2004, researchers from the Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL) led a Level I Process and Energy Optimization Assessment at Rock Island Arsenal (RIA). The team identified 36 process and energy improvement ideas that could significantly improve the RIA manufacturing mission readiness and competitive position. Arsenal staffs selected 28 measures for a follow on Level II analysis. This report documents the Level II analysis results and provides recommendation of 15 "appropriation grade" process improvement projects for Army Energy Conservation Investment Program (ECIP) funding application. If implemented, these projects were estimated to yield annual savings of $0.57M with a total investment of $1.5 M for an average simple payback of 2.6 years. ECIP funding guidance is also included in this report.

15. SUBJECT TERMS

Rock Island Arsenal, IL	facility management	PEPR
energy conservation	emissions	cost analysis

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